JOB NO: 7-5135 BASF
ETT 112 7/26/96

HERCULES
MARINE SERVICE CORP.
FREEPORT, TEXAS

FOREMAN'S DAILY TIME REPORT

DESCRIPTION OF WORK PERFORMED (BY FOREMAN)

JOB NO. 7-5135

DATE 7/26/96

CLASS NO. ETT 112

BADGE NO.	NAME	strip + blow dry; deballast, ballast, nitrogen purge 7/26											TOTAL HOURS
	Claudio Duarte	8 / 3.5											11.5
	Jose Casas	7.5											7.5
	Juan Quintero	7.5											7.5
	Lazaro Cruz	7.5											7.5
	Juan Rivera	8 / 3.5											11.5
	TOTAL HOURS	45.5											45.5

SIGNED ________ FOREMAN   CODED AND EXTENDED BY Bourrous   APPROVED BY ________

HER 00980

HERCULES
MARINE SERVICES CORPORATION
P. O. Drawer O • Freeport, Texas 77541

INVOICE NO. : 3500
DATE : July 31, 1996
Job No. : 7-5135
Location : Freeport, TX

TO:

BASF
607 Copper Road
Freeport, TX 77541

PLEASE REMIT PAYMENTS TO:
11011 RICHMOND
SUITE 500
HOUSTON, TX. 77042

Terms : **Net 30**

FOR:

Service to the ETT 112 as follows:

Set up equipment
Strip out all free product
Blow cargo pipeline and stripping system
Vacuum blow dry cargo tanks
Sweep powder rust from cargo tank floor
Pressure test cargo pipeline 40 PSI
Clean off deck
Remove equipment
Close Barge

De-ballast bow rake to apply temporary patch
Ballast bow rake and wing tank 4
Nitrogen purge

LABOR:	Foreman	8 hr.	@	38.00	304.00
		3.5 hr.	@	53.25 (O/T)	186.38
	Journeyman	30.5 hr.	@	32.50	991.25
		3.5 hr.	@	45.75 (O/T)	160.13
WATER:	64,300 gal		@	5.00/1,000 gal	321.50
STOCK:	32.70	Plus 25%	=	8.18	40.88
EQUIPMENT:	Compressor	5	@	48.00	240.00
	Air Movers	20	@	5.00	100.00
	Vacuum	3	@	30.00	90.00
	Hand Hose	2	@	12.00	24.00
	2" Strip Pump	2	@	15.00	30.00
	3" Gas Pump	3	@	18.00	54.00
				TOTAL AMOUNT DUE	$2,542.14

PHONE: (409) 233-6371

HER 00981

SHIPPING ORDER

DATE ORDERED 7-25-96
WRITTEN BY Steve M
DATE SHIPPED 7-27-96

Big Three Merchant Gases and Equipment, Inc.

Industrial Nitrogen Services

General Office: P.O. BOX 3047 HOUSTON, TEXAS 77253 713/868-0333
Remit Payment to: P.O. BOX 200411 HOUSTON, TEXAS 77216-0411

SHIPPERS ORDER NO. 118- 003944
INVOICE DATE
INVOICE NO.

SOLD TO		SHIP TO	
Account No.		Customer	BASF- Hercules
Customer		Location	Hercules docks
Address		Unit Name	Barge ETT-112
City	State Zip	Services Rendered	Purge
		City	Sulfur(?) State Tx Zip

CUSTOMER ORDER NO.	ORDERED BY	ORIGIN	FROM	TO	TAX %	CREDIT APPROVAL
	JOANNA	118	118	118		

WARNING 1. PRE-JOB DISCUSSION WAS HELD & SAFETY CHECK LIST COMPLETED. ___ INITIAL 2. CUSTOMER HAS RECEIVED A COPY OF SAFETY PRECAUTIONS. ___ INITIAL **WARNING**

THE UNDERSIGNED CUSTOMER AGREES TO BIG THREE INDUSTRIES' GENERAL TERMS AND CONDITIONS OF SERVICE INCLUDING THOSE APPEARING ON THE REVERSE HEREOF:

X [signature] X Foreman X 7-27-96
AUTHORIZED SIGNATURE TITLE DATE

QUANTITY ORDERED	PART NO.	DESCRIPTION	QUANTITY SHIPPED	UNIT COST	UNIT	TAX	AMOUNT
		Service Charge 1					
		Time Charges Pumper 3.5					
		Time Charges Transport —					
		Mileage Pumper 150 R/T					
		Mileage Transport —					
		Nitrogen Charges 120,000					
		P.O. # E91271					
		GOVERNMENT AGENCY REGULATORY COMPLIANCE CHARGE 3.5					
		Subtotal					
		Tax					
		Total					

Credit ______ ☒ 210 Pressure Test/purge ☐ 220 Cool down ☐ 230 Regeneration ☐ 240 Dryout ☐ 250 Saltdome ☐ 270 Pipeline ☐ 280 Ship Purge

EQUIPMENT	UNIT 1	TYPE	UNIT 2	TYPE	UNIT 3	TYPE	UNIT 4	TYPE
Unit No. & Type	3145	Std Pump						
Date & Time Started	7-27-96	Midnite						
Date & Time Completed	7-27-96	0330						
TOTAL N_2 UNIT HOURS		3.5						
Rate SCFM								
TOTAL N_2 USED	120,000							

EQUIPMENT MILEAGE

Roundtrip Miles From: Bayport, Texas
TOTAL CHARGEABLE MILES 150 X No. of Units 1 = 150

TRANSPORT MILEAGE AND TIME

Roundtrip Miles From:
TOTAL CHARGEABLE MILES X No. of Transports
Total Transport Time On Site
Total Chargeable Transport Time

I hereby acknowledge that the above information is correct, and the services have been completed.

Authorized Signature X [signature]
Title Date

Big Three Operators: Steve Manuel
Remarks:

Steve Manuel
Big Three I.N.S. Representative

HER 00982

BIG THREE MERCHANT GASES AND EQUIPMENT, INC.
GENERAL TERMS AND CONDITIONS OF SERVICE

The service consists of delivery of nitrogen or oxygen to the Customer at the Customer's use point (the "site") by means of connections furnished by the Customer, the quantities, pressures and times of delivery being subject to the Customer's directions. The Customer at all times has complete charge, custody, control and responsibility for all tubing or other connections or equipment furnished for the receipt of delivery of the nitrogen or oxygen for the Customer's unit, the conditions within the unit production pipe or other equipment about or in the unit and the premises about the unit.

In consideration of the service and product prices as set out in its current price schedule, it is understood that the services and products of Big Three Industries, Inc., ("Big Three") is offered, furnished and sold only under the following terms and conditions:

(1) A responsible representative of the Customer must be present at all times to designate and provide the point of connection into which nitrogen or oxygen is to be delivered and to designate the quantities of nitrogen or oxygen to be delivered, the pressures at which the same shall be delivered, and the times at which the same shall be delivered.

(2) If, in order to gain access to or to return from the site, it is necessary to repair roads or bridges or to provide tractors, vessels or other special means of transportation for Big Three equipment, material or personnel, such shall be arranged and paid for by the Customer. The Customer shall be fully responsible for and shall indemnify Big Three against any loss arising as a result of any damage to or loss of any of Big Three's equipment or materials while same are being transported to or from the site by means furnished or arranged for by Customer or while such equipment or materials are being loaded upon or attached to any special means of transportation furnished or arranged for by Customer.

(3) Purity of all product furnished under this Agreement shall comply with Compressed Gas Association standards. Big Three's only liability or obligation in respect to any product which fails to meet the standards provided for herein shall be to replace such product at Big Three's expense. BIG THREE MAKES NO WARRANTY OF ANY KIND, EXPRESSLY OR IMPLIED, EXCEPT THAT PRODUCTS DELIVERED HEREUNDER SHALL CONFORM TO COMPRESSED GAS ASSOCIATION STANDARDS UNLESS OTHERWISE SPECIFIED. BIG THREE SHALL NOT BE LIABLE FOR DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND OR FOR DAMAGES ARISING FROM THE PRESENCE OR USE OF PRODUCTS HEREIN CONCERNED, WHETHER USED SINGLY OR IN COMBINATION WITH OTHER SUBSTANCES. THERE ARE NOT ANY WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HERE. Customer shall and does hereby indemnify and hold Big Three harmless against any and all loss, cost, damage, liability, claim or expense, including (but not limited to) attorney's fee, arising out of injury to or death of persons, or damage to or destruction of property, in any manner caused by, resulting from or connected with, the sale or delivery of products concerned hereunder, or Customer's use thereof.

(4) While Big Three will render the services contracted for to the best of its ability, it does not guarantee any results and, except in the case of gross or willful negligence on its part, shall not be liable or responsible for any damage to the site or any equipment located at the site or for any loss or damage whatsoever (including injury to or death of person or property damage) growing out of or in any way connected with its operations and Customer shall absolve and hold Big Three Industries, Inc. harmless against all liability for any such loss or damage sustained or incurred by Customer or any third party irrespective of the cause.

(5) All statements rendered for services performed by Big Three shall be paid at its offices in Houston, Texas within thirty days from date of statement. If not paid within thirty days, the unpaid amount of such bill shall bear interest at the rate of ten per cent per annum and, if necessary to be collected by an attorney, an additional amount shall become due and payable as reasonable attorney's fees.

(6) This contract shall be construed in accordance with the laws of the State of Texas.

(7) All of the preceding terms and conditions shall apply in favor of any manufacturer of supplier of any equipment Big Three may use in the performance or attempted performance of any of its services.

(8) Prices listed in Big Three's current schedule do not include sales or similar taxes and it reserves the right to add such taxes, if any, to its published prices. Any tax based on or measured by the charges made for, or the cash receipts from the sale of materials or products or the rendering of services shall be added to the stated price.

Failure to enforce any or all of the above terms and conditions in a particular instance shall not constitute a waiver of or preclude subsequent enforcement.

No employee is empowered to alter or waive any of above terms and conditions.

Prices are subject to change without notice.

BIG THREE MERCHANT GASES AND EQUIPMENT, INC.
Houston, Texas

HER 00983

[illegible]

[illegible]

[illegible]	HOURS USED	HOURLY RATE	TOTAL PRICE
[illegible]SSOR	5	44.00	
[illegible] COVERS	20	5.00	
[illegible]UUM	3	20.00	
[illegible]ER		80.00	
[illegible] HOSE	2	10.00	
[illegible]TERWORTH		10.00	
[illegible] PUMP	2	12.00	
DIESEL PUMP	3	14.00	
[illegible] PUMP		15.00	
[illegible]		130.00	
[illegible] PICKER		50.00	
[illegible] LIFT		20.00	
[illegible] BOAT		80.00	
[illegible] [illegible]WELINE		15.00	
[illegible] RIG		8.00	
[illegible] BARGE		35.00	
[illegible]		1100.00	

[illegible] 7-26-86 JOB NO: 5135 BARGE NAME: EXT=112

HER 00984

DAILY TIME LOG

DATE:	7-26-86	CUSTOMER:	BASF
JOB NO:		BARGE:	ETC-112

START TIME 7:30 PM STOP TIME 7:00 AM

NAME	HOURS	TOTAL HOURS	NAME	HOURS	TOTAL HOURS
Claudio	11½				
Cano	7½				
Quintero	7½				
Cruz	7½				
Rivera	11½				

MATERIAL LIST:
(3) Three pair Respirator Filters, (4) Four Flashlight Batteries, and (2) Two White Paper Coveralls.

JOB DESCRIPTION:
Strip + Blow Dwg; Deballast Bow Rake to Supply Temp. Patch. Pump out WATER (3 FT.) from wing Tank #3. Ballast Bow Rake + "A" #4.
Nitrogen Pad Barge

HER 00985

Stock Use Breakdown

Job No: 7-5135 Customer: BASF Barge: ETT 112

2	Coveralls	@	2.85	5.70
4	Batteries	@	2.25	9.00
3	Respirator Filters	@	6.00	18.00
	Gloves	@	1.75	
	Flashlights	@	12.00	
	Gaskets	@	6.00	
	Goggles	@	2.95	
	Boots	@	9.00	
	Raincoats	@	36.65	

Total	32.70
Plus 25%	8.18
Charge Customer	40.88

HER 00986

HERCULES
MARINE SERVICES CORPORATION

Strength through environmental awareness and customer service

P.O. Drawer O
Freeport, Texas 77541

Office (409) 233-6371
Fax. (409) 233-6375

Final Check List

DATE: 7-26-96

BARGE: ETT-112

		REPLACED GASKET
BLND NUMBER CHECKED	2	YES ___ NO ✓
GATE VALVE NUMBER CHECKED	6	YES ___ NO ✓
PLUGS NUMBER CHECKED	1	YES ___ NO ✓
CHECK VALVE NUMBER CHECKED	N/A	YES ___ NO ___
DEEPWELL BLIND NUMBER CHECKED	N/A	YES ___ NO ___
BELOW DECK CARGO PIPELINE BLIND NUMBER	___	YES ___ NO ___

BELOW DECK CARGO PIPELINE BLIND REMOVED YES ✓ NO ___

DRIP PAN VALVES: Closed By: Rivera DRIP PANS COVER: Closed by: CASAS

CONTAINMENT AREA PLUG OR VALVES: Closed by: CASAS

AIR TEST CARGO LINE - 40 psi - USING SOAP

SIGNATURE OF TESTER: Alejandro Casas

SIGNATURE OF WITNESS: R. Rivera

* CHECK VALVE GASKET WILL BE REPLACED
* AIR TEST IS LAST THING TO BE DONE BEFORE RELEASING BARGE.

Barge Cleaning Report

JOB NO 5135 ETA _____

BARGE NO ETT 112 DATE/TIME ARRIVAL 7-26-96 8:20 PM

CUSTOMER BASF DATE/TIME START 7-26-96 8:30 PM

PRODUCT CYCLOHEXANE DATE/TIME COMPLETE 7-26-96 12:30 AM

AMOUNT STRIPPED 400

CLEANING INST. BY R Peters COMPLETION SCH. BY R. Peters OVERTIME AUTH. BY R. Peters

BARGE INSP. BY Duarte DATE/TIME 12:00 PM RELEASED TO Brown Water IV DATE/TIME 12:30 AM

DEEPWELL OPENED: YES N/A NO___ CLOSED BY_____ NEW GASKET: YES___ NO___

BELOW DECK CARGO PIPELINE:

BLIND OPENED: YES ✓ NO___ CLOSED BY CASHS NEW GASKET: YES___ NO___

DECK CHECK VALVE OPENED: YES N/A NO___ CLOSED BY_____ NEW GASKET: YES___ NO___

DECK HEADER BLINDS OPENED: YES ✓ NO___ INSECTED BY CALEB BRETT_____

DECK HEADER DRAIN PLUG OPENED: YES ✓ NO___ CLOSED BY Quinton

VAPOR RECOVERY HEADER OPENED: YES ✓ NO___ CLOSED BY CASAS NEW GASKET: YES___ NO ✓

RUST SCALE: YES ✓ NO___ WASHED OUT_____ BUCKETED OUT_____

NUMBER OF CARGO TANKS 3 CONDITION OF CARGO VALVES GOD

SLOP TANK STRIPPED: YES N/A NO___ DRIP PANS STRIPPED: YES ✓ NO___

WEATHER: TEMP___ RAIN___ FOG___ HUMIDITY ✓ OVERCAST___ CLOUDY ✓ CLEAR___

PIPELINE WASHED: YES___ NO ✓ PIPELINE BLOWN: YES ✓ NO___ INSPECTED BY CALEB BRETT_____

BOW RAKE CHECKED: YES ✓ NO___ STERN RAKE CHECKED: YES ✓ NO___

VOIDS: YES ✓ NO___ SAFETY EQUIPMENT USED: _____

SUMPS INSPECTED: ✓

NOTICE

All barges cleaned for BASF will be inspected by Caleb Brett. The inspector will have paperwork for the Hercules foreman in charge to sign. The foreman will put two copies in the document mail box. One copy will stay in the mailbox, and the captain of the tugboat that is picking up the barge will not be called until inspection is completed and documentation is in the mailbox. If any problems, BASF logistics representative must be contacted.

Date Inspected 7/27/96 Time in: 0015 Time out: 0035

Inspected By: Caleb Brett

NO BASF BARGE THAT HAS BEEN CLEANED WILL BE RELEASED UNTIL CALEB BRETT HAS SIGNED THE RELEASE PAPERS. CALEB BRETT WILL BE GIVEN A COPY OF THIS FORM.

HER 00988

Inchcape Testing Services
Caleb Brett

YOUR REFERENCE
OUR REFERENCE

TIME LOG

VESSEL	PRODUCT/CARGO	PORT/TERMINAL	DATE
ETT-112	N/A	Hercules	7-27-96

MONTH	DAY	HOUR	EVENT
7	26	1130	inspector notified
7	27	1215	inspector arrived
		1220	Commenced barge Pre-inspection
		1225	Witnessed cargo lines blown
		1230	Completed barge pre-inspection
		1235	Final paperwork completed

For Vessel

FOR CALEB BRETT

HER 00989

FORM # 2-044-95

Inchcape Testing Services
Caleb Brett

YOUR REFERENCE

OUR REFERENCE

VISUAL TANK INSPECTION REPORT

VESSEL	PRODUCT / CARGO	PORT / TERMINAL	DATE
ETT-112	N/A	Hercules	7-27-96

Tank Number	1,2,3c						
Tank Coating	N/A						
Last Cargo	Cyclo						
Second Last Cargo	↓						
Third Last Cargo	↓						
Time/Date Inspected	7-27-96 @ 30						
Visual Cleanliness Accepted/Rejected*	accepted						
Reason for Rejection	—						

Method said to have been used to clean tanks:	TK#	Strip + Blow
	TK#	Strip chemical for 1 hour total.
	TK#	Blow pipeline + cargo tank for ~2hr 45 min.
	TK#	vented for 5 hrs.
	TK#	
	TK#	
	TK#	

Information regarding previous cargoes, tank coating and cleaning method was obtained from vessel personnel and cannot be guaranteed as accurate by Caleb Brett and no liability can be assumed for errors resulting from improper information supplied. This report, of necessity, is based on such information.

* The cleanliness of inspected tank(s) is/are based on visual inspection of tank surfaces and line system at accessible areas only. This document does not cover the cleanliness of tank surfaces and line system at inaccessible spots and/or possible release of components of previous cargoes during loading, discharge or transport of the cargo in question, for which the vessel is fully responsible. Suitability of tank coating for intended cargo must be guaranteed by vessel's owner or by suppliers of the coating.

Form # 2-056-94A

FOR CALEB BRETT

HER 00990

HAZARDS COMMUNICATION STANDARD

OSHA 1910.1200

EMPLOYEE HAZARDOUS MATERIALS TRAINING PROGRAM

Date 7-26-86

Plant Hercules

Area Haz Fore Dock

E++= 112

Supervisor [signature]

Client Safety ______

The following listed materials are considered to be hazardous to the employees working in this area:

Cyclohexane

The employees assigned to work in this area have been informed of the hazardous materials in this area, the hazards they present to the workers, the location of hazards listed, the protective equipment that has been provided and where it is located, and procedures to be followed in case of an accidental exposure. I have received the training listed above and will so designate by signing this form.

NAME	BADGE	NAME	BADGE
[signature]	70		
Jose A. Casas			
Lazaro Cruz			
Juan J. Quintero			

HER 00991

DECLARATION OF INSPECTION PRIOR TO BULK CARGO TRANSFER

VESSELS: BASE / EH2112

TRANSFER FACILITY: Hercules Gas Free Dock

LOCATION: FREEPORT TX.

The following list refers to requirements set forth in detail in 33 CFR 156.150 and 46 CFR 35.35-30 (printed on reverse). The spaces adjacent to items on the list are provided to indicate that the detailed requirement has been met.

	DELIVERER	RECEIVER
1. Communication System/Language Fluency (156.120) (n) (p))	✓	✓
* 2. Warning Signs and red Warning Signals. (35.35-30)	✓	✓
3. Vessels Moorings. (156.120 (a))	✓	✓
4. Transfer System Alignment. (156.120 (d))	✓	✓
5. Transfer System; unused components. (156.120 (e))	✓	✓
6. Transfer Systems; fixed piping. (156.120 (f))	✓	✓
7. Overboard Discharges/Sea Suction Valves. (156.120 (g))	✓	✓
8. Hoses or Loading Arms condition. (156.120 (h) (156.170)	✓	✓
9. Hoses; length and support. (156.120 (b) (c))	✓	✓
10. Connections. (156.130)	✓	✓
11. Discharge Containment Systems. (156.120 (j) (l))	✓	✓
12. Scuppers or Drains. (156.120 (k))	✓	✓
13. Emergency Shutdown (156.120 (n)	✓	✓
* 14. Repair Work Authorization. (35.35-30)	N/A	N/A
* 15. Boiler and Galley Fires Safety. (35.35-30)	N/A	N/A
* 16. Fires or Open Flames (35.35-30)	N/A	N/A
17. Lighting (sunset to sunrise). (156.120 (t))	✓	✓
* 18. Safe Smoking Spaces. (35.35-30)	✓	✓
19. Spill and Emergency shutdown procedures. (156.120 (q))	✓	✓
20. Sufficient Personnel. (156.120 (o) (s))	✓	✓
21. Transfer Conference. (156.120 (q))	✓	✓
22. Agreement to begin transfer. (156.120 (r))	✓	✓

I do certify that I have personally inspected this facility or vessel with reference to the requirements printed on reverse and that opposite each of them I have indicated that the regulations have been complied with.

Person in Charge, Receiving Unit	TITLE	TIME & DATE
[signature]	Foreman	7-26-96 8:30 PM
Person in Charge, Delivering Unit		
[signature]	FUEL PERSON	

TIME COMPLETED 7-26-96 12:30 AM

HER 00992

* Rules and Regulations for Tank Vessels.

Job Workscope/Breakdown

Job No: 7-5135 Date: 7/26/96 Invoice Number: 3500

Customer: BASF Barge/M/V: ETT 112

Foreman:	S/T	8	@	38.00	304.00
	O/T	3.5	@	53.25	186.38
Leadman:	S/T		@	35.00	
	O/T		@	49.50	
Journeyman:	S/T	~~30~~ 30.5	@	32.50	991.25
	O/T	3.5	@	45.75	160.13
Disposal:	Slop Oil		@	0.60	
	Water		@	0.35	
Water:		64,300	@	5.00/1,000 gal	321.50
Material:			Plus 25%		
Stock:		32.70	Plus 25%	8.18	40.88
Chemist:			Plus 25%		
Equipment:	Compressor	5	@	48.00	240.00
	Air Movers	20	@	5.00	100.00
	Forklift		@	30.00	
	Tugboat		@	100.00	
	Steam Rig		@	100.00	
	Vacuum	3	@	30.00	90.00
	Hand Hose	2	@	12.00	24.00
	Weld Machine		@	15.00	
	Cherry Picker		@	70.00	
	Crane		@	130.00	
	3" Gas Pump	3	@	18.00	54.00
	2" Strip Pump	2	@	15.00	30.00
	Butterworth		@	10.00	
	4" Elec. Pump		@	15.00	
	Cutting Rig		@	8.00	
	Haul Out		@	1,100.00	
	Truck		@	25.00	
	Hand Tools		@	10.00	

Total Invoice: $ 2,542.14

HER 00993

HAZARD COMMUNICATION PACKET

Industrial **S**pecial
Nitrogen & **O**xygen
S ervice **S** ervice

AIR LIQUIDE™

This envelope contains:

- ☐ Nitrogen MSDS
- ☐ Oxygen MSDS
- ☐ Safety Checklist
- ☐ Safety Precautions Pamphlet
- ☐ Other: _____

For additional safety information, contact INS/SOS at:
AIR LIQUIDE AMERICA, PO Box 3047, Houston, TX 77253, or
(713) 896-2265

HER 00994

AIR LICUICE AMERICA CORPORATION
P. O. BOX 3047
HOUSTON, TX 77253

M A T E R I A L S A F E T Y D A T A S H E E T

I - G E N E R A L I N F C R M A T I O N

PRCDUCT NAME NITROGEN, REFRIGERATED LIQUID

EMERGENCY TELEPHONE NO. 713-868-0302
MANUFACTURERS NAME AIR LICUICE AMERICA CORP.
TRADE NAME/SYNONYMS LIQUID NITROGEN (LIN)
CHEMICAL NAME AND SYNONYMS
NITROGEN, REFRIGERATED LIQUID
REVISION DATE: 08/24/89 PRODUCT ID. UN 1977 FORMULA N2
CHEMICAL FAMILY INERT GAS CAS NUMBER 7727-37-9

SHELL CURRENT
5-1-96 ALAC/RLP

********** SECTION NOTES **********

MSDS INFCRMATION NUMBER: (713) 896-2140

I I - H A Z A R D O U S I N G R E D I E N T S

HAZARDOUS MIXTURES OF LIQUIDS AND GASES	O/O	TLV
NITROGEN	100	**

** NONE ESTABLISHED

I I I - P H Y S I C A L D A T A

BOILING POINT -320.4F (-195.8C) @ 1 ATM
SPECIFIC GRAVITY (H20 = 1): 0.8083 @ BOILING PT. & 1 ATM
VAPOR PRESSURE N/A
PERCENT VCLATILE BY VOLUME (O/O) N/A
DENSITY 50.49 LB/CU FT @ BOILING PT. @ 1 ATM
EVAPCRATION RATE N/A
SCLUBILITY IN WATER N/A
MATERIAL AT NORMAL CONDITION LIQUID
EXPANSION RATIO (LIQUID TO GAS) 1:696.5

APPEARANCE AND CDOR

COLORLESS, CDORLESS GAS

IV - F I R E A N C E X P L C S I O N H A Z A R D D A T A

FLASH PCINT N/A
FLASH PCINT (METHOD USED)
FLAMMABILITY LIMITS IN AIR (O/O BY VOL) LOWER N/A UPPER N/A

EXTINGUISHING MEDIA

MATERIAL IS NONFLAMMABLE. NITROGEN NEITHER BURNS NOR SUPPORTS COMBUSTION. USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE FIGHTING PROCEDURES

NONE. NITROGEN WILL ACT AS A SIMPLE ASPHYXIANT IT IT DISPLACES OXYGEN. LIQUID NITROGEN WHEN SPILLED WILL VAPORIZE RAPIDLY CAUSING A VAPOR CLOUD THAT WILL CREATE AN OXYGEN-DEFICIENT ATMOSPHERE. EVACUATE THE AREA OF THIS VAPOR CLOUD UNLESS WEARING SELF-CONTAINED BREATHING APPARATUS.

UNUSUAL FIRE AND EXPLOSION HAZARD

CONTACT WITH "COLD" LIQUID OR GASEOUS NITROGEN MAY CAUSE FROSTBITE. VISIBILITY MAY BE OBSCURED IN THIS "VAPOR CLOUD".

AUTOIGNITION TEMPERATURE: N/A

M A T E R I A L S A F E T Y D A T A S H E E T

PRODUCT NAME NITROGEN, REFRIGERATED LIQUID

ELECTRICAL CLASSIFICATION: NONHAZARDOUS

V - H E A L T H H A Z A R D D A T A

THRESHOLD LIMIT VALUE — NONE ESTABLISHED

UNUSUAL CHRONIC TOXICITY — *SEE OVEREXPOSURE SECTION*

CARCINOGENICITY — NOT LISTED BY IARC, NTP, OSHA

ROUTES OF EXPOSURE — INHALATION, EYE/SKIN CONTACT

EFFECTS OF OVEREXPOSURE

NITROGEN IS NONTOXIC, BUT MAY CAUSE SUFFOCATION BY DISPLACING THE OXYGEN IN THE AIR. EXPOSURE TO OXYGEN-DEFICIENT ATMOSPHERES MAY CAUSE DIZZINESS, NAUSEA, VOMITING, DIMINISHED MENTAL ALERTNESS, LOSS OF CONSCIOUSNESS, AND DEATH. IT SHOULD BE RECOGNIZED THAT COLLAPSE AND ASPHYXIATION MAY OCCUR WITHOUT EXPERIENCING ANY OF THE ABOVE SYMPTOMS. PROLONGED BREATHING OF VERY COLD ATMOSPHERES CAN CAUSE LUNG DAMAGE AND HYPOTHERMIA. FROZEN TISSUES, CAUSED BY FROSTBITE ARE PAINLESS AND APPEAR WAXY WITH A POSSIBLE YELLOW COLOR. THEY WILL BECOME SWOLLEN, PAINFUL, AND PRONE TO INFECTION WHEN THAWED.

TOXICOLOGICAL PROPERTIES:

NITROGEN IS A SIMPLE ASPHYXIANT.

CONTACT WITH COLD LIQUID OR PIPING MAY CAUSE COLD CONTACT BURNS, "FROSTBITE".

EMERGENCY AND FIRST AID PROCEDURES

PERSONS SUFFERING FROM LACK OF OXYGEN SHOULD BE MOVED INTO FRESH AIR. IF VICTIM IS NOT BREATHING, ADMINISTER ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. OBTAIN PROMPT MEDICAL ATTENTION.

SELF-CONTAINED BREATHING APPARATUS MAY BE REQUIRED FOR RESCUE WORKERS.

IF CONTACT WITH CRYOGENIC LIQUID NITROGEN HAS CAUSED FROSTBITE, DO NOT RUB THE AFFECTED AREA, AS TISSUE DAMAGE MAY OCCUR. FLUSH THE AFFECTED AREAS WITH WARM WATER. DO NOT USE HOT WATER. OBTAIN PROMPT MEDICAL ATTENTION.

V I - R E A C T I V I T Y D A T A

STABILITY STABLE

CONDITIONS TO AVOID

NONE.

INCOMPATABILITY (MATERIALS TO AVOID)

NONE.

HAZARDOUS DECOMPOSITION PRODUCTS

NONE.

HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID

NONE.

V I I - S P I L L O R L E A K P R O C E D U R E S

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

EVACUATE ALL UNNECESSARY PERSONNEL FROM VAPOR CLOUD AREA WHERE AN OXYGEN-DEFICIENT ATMOSPHERE IS PROBABLE. SHUT OFF NITROGEN SOURCE IF POSSIBLE. AVOID CONTACT WITH LIQUID NITROGEN OR ITS COLD BOIL-OFF GAS. TO INCREASE RATE OF EVAPORATION SPRAY WITH LARGE AMOUNTS OF WATER FROM UPWIND. IF LEAKING FROM CONTAINER OR CONNECTION, CONTACT THE CLOSEST BIG THREE INDUSTRIES LOCATION, OR YOUR SUPPLIER. SELF-CONTAINED BREATHING APPARATUS WILL BE REQUIRED IN OXYGEN-DEFICIENT AREAS SUCH AS NITROGEN VAPOR CLOUDS.

WASTE DISPOSAL METHOD

DO NOT ATTEMPT TO DISPOSE OF RESIDUAL OR UNUSED QUANTITIES. RETURN TO YOUR SUPPLIER FOR DISPOSAL. FOR EMERGENCY DISPOSAL, ALLOW LIQUID NITROGEN TO EVAPORATE IN A WELL-VENTILATED OUTDOOR LOCATION.

V I I I - S P E C I A L P R C T E C T I V E I N F O R M A T I O N

RESPIRATORY PROTECTION (SPECIFY TYPE)

USE SELF-CONTAINED BREATHING APPARATUS OR POSITIVE PRESSURE AIR LINE WITH MASK IN OXYGEN-DEFICIENT ATMOSPHERES. RESPIRATORS WILL NOT FUNCTION.

VENTILATION

SEE NOTES

PROTECTIVE GLOVES

LOOSE-FITTING THERMAL INSULATED/LEATHER

EYE PROTECTION

FULL FACE SHIELD AND SAFETY GLASSES ARE RECOMMENDED WHEN HANDLING N2 LIQUID

OTHER PROTECTIVE EQUIPMENT

LONG SLEEVE SHIRT FOR LIQUID HANDLING.
SAFETY SHOES IF HANDLING CYLINDERS.

********** SECTION NOTES **********

ADEQUATE TO AVOID LOWERING OXYGEN CONTENT TO BELOW 19.5 % (OXYGEN-DEFICIENT ATMOSPHERE).

LOCAL EXHAUST: YES
MECHANICAL: YES

I X - S P E C I A L P R E C A U T I O N S

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

STORE AND USE WITH ADEQUATE VENTILATION. CONTAINERS SHOULD BE STORED UPRIGHT AND FIRMLY SECURED TO PREVENT FALLING OR BEING KNOCKED OVER. PROTECT CONTAINERS FROM PHYSICAL DAMAGE; DO NOT DRAG, ROLL, SLIDE, OR DROP. USE A SUITABLE HAND TRUCK FOR CONTAINER MOVEMENT. LIQUID CONTAINERS (I.E.: 4L CYLINDERS) WILL VENT NITROGEN IF INTERNAL PRESSURE BUILDS UP, SO THESE CONTAINERS SHOULD BE STORED IN WELL-VENTILATED AREAS.

D.O.T. LABELING

NONFLAMMABLE GAS - GREEN LABEL

VALVE CONNECTION

295 FOR LIQUID, 580 FOR GAS

OTHER PRECAUTIONS

LIQUID NITROGEN EXPANDS AT A RATIO OF 696.5 TO 1, AND IF TRAPPED IN A CONTAINER OR PIPE, IT WILL PRODUCE ENORMOUS PRESSURES WHICH WILL RUPTURE THE CONTAINER. ANY AREA WHERE LIQUID NITROGEN COULD BE TRAPPED MUST BE PROTECTED BY A PRESSURE RELIEF DEVICE. PIPING MUST BE DESIGNED FOR EXTREME COLD. MANY MATERIALS, SUCH AS CARBON STEEL, WILL BECOME BRITTLE AND MAY FRACTURE WHEN EXTREMELY COLD. DO NOT TOUCH COLD PIPING AS FROSTBITE MAY OCCUR.

DOT PLACARD: NONFLAMMABLE GAS

DOT PROPER SHIPPING NAME: NITROGEN, REFRIGERATED LIQUID

MISCELLANEOUS INFORMATION:

FURTHER INFORMATION ABOUT LIQUID NITROGEN CAN BE FOUND IN THE FOLLOWING PAMPHLETS PUBLISHED BY:

THE COMPRESSED GAS ASSOCIATION (CGA)
1235 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VA 22202
(703) 979-4341

G-10.1: "COMMODITY SPECIFICATION FOR NITROGEN"
P-1: "SAFE HANDLING OF COMPRESSED GASES IN CONTAINERS"
P-9: "THE INERT GASES ARGON, NITROGEN, AND HELIUM"
P-12: "SAFE HANDLING OF CRYOGENIC LIQUID"
P-14: "ACCIDENT PREVENTION IN OXYGEN-RICH AND OXYGEN-DEFICIENT ATMOSPHERES"
SB-2: "OXYGEN-DEFICIENT ATMOSPHERES"
AV-5: "SAFE HANDLING OF LIQUEFIED NITROGEN & ARGON"

NFPA RATINGS:
HEALTH: 3
FLAMMABILITY: 0
REACTIVITY: 0

HMIS RATINGS:
HEALTH: 3
FLAMMABILITY: 0
REACTIVITY: 0

CERCLA RATINGS:
HEALTH: 0
FIRE: 0
REACTIVITY: 0
PERSISTANCE: 3

LISTED IN TSCA INVENTORY: YES

MATERIAL SAFETY DATA SHEET

PRODUCT NAME NITROGEN, REFRIGERATED LIQUID

THIS PRODUCT SAFETY DATA SHEET IS OFFERED SOLELY FOR YOUR INFORMATION, CONSIDERATION, INVESTIGATION, IN COMPLIANCE WITH HAZARD COMMUNICATION STANDARD 29 CFR 1910.1200. AIR LIQUIDE AMERICA CORP. PROVIDES NO WARRANTIES, EITHER EXPRESS OR IMPLIED.

AIR LIQUIDE AMERICA CORPORATION
P. O. BOX 3047
HOUSTON, TX 77253

M A T E R I A L S A F E T Y D A T A S H E E T

I - G E N E R A L I N F O R M A T I O N

PRODUCT NAME OXYGEN, REFRIGERATED LIQUID

CURRENT
5-1-96 AMA/RLP

EMERGENCY TELEPHONE NO. 713-868-0302
MANUFACTURERS NAME AIR LIQUIDE AMERICA CORP.
TRADE NAME/SYNONYMS LIQUID OXYGEN (LOX)
CHEMICAL NAME AND SYNONYMS
OXYGEN, REFRIGERATED LIQUID
REVISION DATE: 09/05/89 PRODUCT ID. UN 1073 FORMULA O2
CHEMICAL FAMILY OXIDIZER CAS NUMBER 7782-44-7

********** SECTION NOTES **********

MSDS INFORMATION NUMBER: (713) 896-2140

II - H A Z A R D O U S I N G R E D I E N T S

HAZARDOUS MIXTURES OF LIQUIDS AND GASES	O/O	TLV
OXYGEN	100	**
** NONE ESTABLISHED		

III - P H Y S I C A L D A T A

BOILING POINT -297.3F (-183.0C) @ 1 ATM
SPECIFIC GRAVITY (H2O = 1): 1.14 @ BOILING PT & 1 ATM
VAPOR PRESSURE N/A
PERCENT VOLATILE BY VOLUME (O/O) N/A
DENSITY 71.22 LB/CU FT
@ BOILING PT & 1 ATM
EVAPORATION RATE N/A
SOLUBILITY IN WATER N/A
MATERIAL AT NORMAL CONDITION LIQUID
EXPANSION RATIO (LIQUID TO GAS) 1:860.6

APPEARANCE AND ODOR

PALE BLUE, ODORLESS LIQUID

IV - F I R E A N D E X P L O S I O N H A Z A R D D A T A

FLASH POINT N/A
FLASH POINT (METHOD USED)
FLAMMABILITY LIMITS IN AIR (O/O BY VOL) LOWER N/A UPPER N/A

EXTINGUISHING MEDIA

MATERIAL IS NONFLAMMABLE. USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE FIGHTING PROCEDURES

THOUGH NOT FLAMMABLE ITSELF, OXYGEN VIGOROUSLY ACCELERATES COMBUSTION. LIQUID OXYGEN, WHEN SPILLED, WILL EVAPORATE RAPIDLY CAUSING A VAPOR CLOUD THAT WILL BE HIGHLY OXYGEN-ENRICHED, WHICH CAN CAUSE MATERIALS IN THIS CLOUD TO IGNITE EASILY. EVACUATE THE CLOUD AREA AND REMOVE ANY IGNITION SOURCES.

UNUSUAL FIRE AND EXPLOSION HAZARD

MATERIALS WHICH DO NOT BURN IN AIR MAY BURN IN OXYGEN-ENRICHED ATMOSPHERES WHERE THE OXYGEN CONTENT EXCEEDS 21%. OXYGEN MAY FORM EXPLOSIVE COMPOUNDS WHEN EXPOSED TO COMBUSTIBLE MATERIALS OR OIL, GREASE, AND OTHER HYDROCARBON

MATERIALS. CONTACT WITH "COLD" REFRIGERATED LIQUID MAY CAUSE FROSTBITE. VISIBILITY MAY BE OBSCURED IN THIS VAPOR CLOUD.

AUTOIGNITION TEMPERATURE: N/A

ELECTRICAL CLASSIFICATION: NONHAZARDOUS

V - H E A L T H H A Z A R D D A T A

THRESHOLD LIMIT VALUE — NONE ESTABLISHED

UNUSUAL CHRONIC TOXICITY — *SEE OVEREXPOSURE SECTION*

CARCINOGENICITY — NOT LISTED BY IARC, NTP, OSHA

ROUTES OF EXPOSURE — INHALATION, EYE/SKIN CONTACT

EFFECTS OF OVEREXPOSURE

CONTACT WITH LIQUID OXYGEN CAN CAUSE SEVERE FROSTBITE AND FREEZE BURNS. PROLONGED BREATHING OF VERY COLD ATMOSPHERES CAN CAUSE LUNG DAMAGE AND HYPOTHERMIA. BREATHING 80% OR MORE OXYGEN AT ATMOSPHERIC PRESSURE FOR MORE THAN A FEW HOURS MAY CAUSE NASAL STUFFINESS, COUGH, SORE THROAT, CHEST PAIN AND BREATHING DIFFICULTY. BREATHING OXYGEN AT HIGHER PRESSURE INCREASES THE LIKELIHOOD OF ADVERSE EFFECTS WITHIN A SHORTER TIME PERIOD. EXPOSURE TO OXYGEN AT HIGHER PRESSURES FOR PROLONGED PERIODS HAS BEEN FOUND TO AFFECT VISION, NEUROMUSCULAR COORDINATION, AND ATTENTIVE POWERS.

TOXICOLOGICAL PROPERTIES:

AT NORMAL CONCENTRATION AND PRESSURE, OXYGEN POSES NO TOXICITY HAZARDS. HOWEVER, AT ELEVATED CONCENTRATIONS AND PRESSURES, OXYGEN MAY CAUSE ADVERSE EFFECTS (SEE ABOVE).

EMERGENCY AND FIRST AID PROCEDURES

REDUCE OXYGEN PRESSURES TO 1 ATM AND/OR MOVE VICTIM INTO FRESH AIR.

RESCUE PERSONNEL SHOULD BE AWARE OF EXTREME FIRE HAZARDS ASSOCIATED WITH OXYGEN-ENRICHED ATMOSPHERES.

IF CONTACT WITH CRYOGENIC LIQUID OXYGEN HAS CAUSED FROSTBITE DO NOT RUB THE AFFECTED AREA, AS TISSUE DAMAGE MAY OCCUR. FLUSH THE AFFECTED AREAS WITH WARM WATER. DO NOT USE HOT WATER. OBTAIN PROMPT MEDICAL ATTENTION.

V I - R E A C T I V I T Y D A T A

STABILITY STABLE

CONDITIONS TO AVOID

NONE.

INCOMPATABILITY (MATERIALS TO AVOID)

OXYGEN REACTS EXPLOSIVELY WITH ETHERS, ALCOHOLS, AND HYDROCARBON MATERIALS. KEEP OXYGEN CONTAINERS FREE OF OIL AND/OR GREASE.

HAZARDOUS DECOMPOSITION PRODUCTS

NONE.

HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID

NONE.

V I I - S P I L L O R L E A K P R O C E D U R E S

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

EVACUATE ALL UNNECESSARY PERSONNEL FROM VAPOR CLOUD AREA WHERE AN OXYGEN-ENRICHED ATMOSPHERE IS FORMED, AND ELIMINATE ANY SOURCES OF HEAT OR IGNITION. SHUT OFF SOURCE OF OXYGEN IF POSSIBLE. VENTILATE AREA TO PREVENT OXYGEN-ENRICHED ATMOSPHERE. AVOID CONTACT WITH LIQUID OXYGEN OR ITS COLD BOIL-OFF GAS. TO INCREASE RATE OF EVAPORATION, SPRAY WITH LARGE AMOUNTS OF WATER FROM UPWIND. IF LEAKING FROM CONTAINER OR CONNECTION, CONTACT THE CLOSEST BIG THREE INDUSTRIES LOCATION, OR YOUR SUPPLIER.

WASTE DISPOSAL METHOD

DO NOT ATTEMPT TO DISPOSE OF RESIDUAL OR UNUSED QUANTITIES. RETURN TO YOUR SUPPLIER FOR DISPOSAL. FOR EMERGENCY DISPOSAL, ALLOW LIQUID OXYGEN TO EVAPORATE IN A WELL-VENTILATED, CLEAN (GREASE-FREE), OUTDOOR LOCATION. KEEP AREA FREE FROM SPARKS OR FLAMES AND ANY HYDROCARBON MATERIALS.

V I I I - S P E C I A L P R O T E C T I V E I N F O R M A T I O N

RESPIRATORY PROTECTION (SPECIFY TYPE)

NONE.

VENTILATION

NATURAL OR MECHANICAL WHERE GAS IS PRESENT -- *SEE NOTES*

PROTECTIVE GLOVES

SEE NOTES

EYE PROTECTION

FULL FACE SHIELD AND SAFETY GLASSES ARE RECOMMENDED WHEN HANDLING LIQUID OXYGEN.

OTHER PROTECTIVE EQUIPMENT

LONG SLEEVE SHIRT FOR LIQUID HANDLING.
SAFETY SHOES IF HANDLING CYLINDERS.

********** SECTION NOTES **********

LOCAL EXHALST: SUFFICIENT TO PREVENT OXYGEN-ENRICHED ATMOSPHERES OF OVER 21% OXYGEN.

GLOVES: LOOSE FITTING THERMAL INSULATED OR LEATHER. GLOVES MUST BE CLEAN AND GREASE FREE.

M A T E R I A L S A F E T Y D A T A S H E E T

PRODUCT NAME OXYGEN, REFRIGERATED LIQUID

I X - S P E C I A L P R E C A U T I O N S

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

STORE AND USE WITH ADEQUATE VENTILATION. OXYGEN IS HEAVIER THAN AIR AND LEAKING GAS CAN ACCUMULATE IN LOW AREAS OR CONFINED SPACES CAUSING AN OXYGEN-ENRICHED ATMOSPHERE. CONTAINERS SHOULD BE STORED UPRIGHT AND FIRMLY SECURED TO PREVENT FALLING OR BEING KNOCKED OVER. PROTECT CONTAINERS FROM PHYSICAL DAMAGE; DO NOT DRAG, ROLL, SLIDE OR DROP. USE A SUITABLE HAND TRUCK FOR CONTAINER MOVEMENT. LIQUID CONTAINERS (I.E.: 4L CYLINDERS) WILL VENT OXYGEN IF INTERNAL PRESSURE BUILDS UP, SO THESE CONTAINERS SHOULD BE STORED IN WELL-VENTILATED AREAS. BULK OXYGEN STORAGE MUST MEET EXPOSURE SEPARATION REQUIREMENTS OUTLINED IN NFPA PAMPHLET 50.

D.O.T. LABELING

OXYGEN -- YELLOW LABEL

VALVE CONNECTION

440 FOR LIQUID; 540 FOR GAS

OTHER PRECAUTIONS

LIQUID OXYGEN EXPANDS AT A RATIO OF 860.6 - 1, AND IF TRAPPED IN A CONTAINER OR PIPE, IT WILL PRODUCE ENORMOUS PRESSURES WHICH WILL RUPTURE THE CONTAINER. ANY AREA WHERE LIQUID OXYGEN COULD BE TRAPPED MUST BE PROTECTED BY A PRESSURE RELIEF DEVICE. PIPING MUST BE DESIGNED FOR EXTREME COLD. MANY MATERIALS, SUCH AS CARBON STEEL, WILL BECOME BRITTLE AND MAY FRACTURE WHEN EXTREMELY COLD. DO NOT TOUCH COLD PIPING, AS FROSTBITE MAY OCCUR. ALL GAUGES, VALVES, REGULATORS, PIPING AND EQUIPMENT TO BE USED IN OXYGEN SERVICE MUST BE CLEANED FOR OXYGEN SERVICE IN ACCORDANCE WITH CGA PAMPHLET G-4.1.

DOT PLACARD: OXYGEN

DOT PROPER SHIPPING NAME: OXYGEN, REFRIGERATED LIQUID

MISCELLANEOUS INFORMATION:

FURTHER INFORMATION ABOUT LIQUID OXYGEN CAN BE FOUND IN THE FOLLOWING PAMPHLETS PUBLISHED BY:

THE COMPRESSED GAS ASSOCIATION (CGA)
1235 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VA 22202
(703) 979-4341

G-4.3: "COMMODITY SPECIFICATION FOR OXYGEN"
G-4: "OXYGEN"
G-4.1: "CLEANING EQUIPMENT FOR OXYGEN SERVICE"
P-1: "SAFE HANDLING OF COMPRESSED GASES IN CONTAINERS"
P-12: "SAFE HANDLING OF CRYOGENIC LIQUIDS"
P-14: "ACCIDENT PREVENTION IN OXYGEN-RICH AND OXYGEN-DEFICIENT ATMOSPHERES"
SB-8: "USE OF OXY-FUEL GAS WELDING AND CUTTING APPARATUS"
AV-8: "CHARACTERISTICS AND SAFE HANDLING OF CRYOGENIC LIQUID AND GASEOUS OXYGEN"

NFPA RATINGS:
HEALTH: 3
FLAMMABILITY: 0
REACTIVITY: 0

HMIS RATINGS:
HEALTH: 3

M A T E R I A L S A F E T Y D A T A S H E E T

PRODUCT NAME OXYGEN, REFRIGERATED LIQUID

FLAMMABILITY: 0
REACTIVITY: 0

CERCLA RATINGS:
HEALTH: 0
FIRE:0
REACTIVITY: 0
PERSISTANCE: 3

LISTED IN TSCA INVENTORY: YES

THIS PRODUCT SAFETY DATA SHEET IS OFFERED SOLELY FOR YOUR INFORMATION, CONSIDERATION, INVESTIGATION, IN COMPLIANCE WITH HAZARD COMMUNICATION STANDARD 29 CFR 1900.1200. AIR LIQUIDE AMERICA CORP. PROVIDES NO WARRANTIES, EITHER EXPRESS OR IMPLIED.

AIR LIQUIDE AMERICA CORPORATION
P. O. BOX 3047
HOUSTON, TX 77253

M A T E R I A L S A F E T Y D A T A S H E E T

I - G E N E R A L I N F O R M A T I O N

PRODUCT NAME OXYGEN

EMERGENCY TELEPHONE NO. 713-868-0302 3-1-96 ALAC/REP.
MANUFACTURERS NAME AIR LIQUIDE AMERICA CORP.
TRADE NAME/SYNONYMS OXYGEN; OXYGEN USP; AVIATORS BREATHING OXYGEN (ABO)
CHEMICAL NAME AND SYNONYMS
OXYGEN
REVISION DATE: 09/05/89 PRODUCT ID. UN 1072 FORMULA O2
CHEMICAL FAMILY OXIDIZER CAS NUMBER 7782-44-7

********** SECTION NOTES **********

MSDS INFORMATION NUMBER: (713) 896-2140

II - H A Z A R D O U S I N G R E D I E N T S

HAZARDOUS MIXTURES OF LIQUIDS AND GASES	O/O	TLV
OXYGEN	100	**

** NONE ESTABLISHED

III - P H Y S I C A L D A T A

BOILING POINT -297.3F (-183.0C) @ 1 ATM
SPECIFIC GRAVITY (AIR = 1): 1.1049 @ 70F (21.1C) & 1 ATM
VAPOR PRESSURE N/A
PERCENT VOLATILE BY VOLUME (O/O) N/A (GAS)
DENSITY 0.0827 LB/CU FT
@ 70 F (21.1 C) & 1 ATM
EVAPORATION RATE N/A (GAS)
SOLUBILITY IN WATER 4.89SCC/100CC H2O @ 32 F (0 C)
MATERIAL AT NORMAL CONDITION GAS
EXPANSION RATIO (LIQUID TO GAS) N/A (GAS)

APPEARANCE AND ODOR

COLORLESS, ODORLESS, TASTELESS GAS

IV - F I R E A N D E X P L O S I O N H A Z A R D D A T A

FLASH POINT N/A
FLASH POINT (METHOD USED)
FLAMMABILITY LIMITS IN AIR (O/O BY VOL) LOWER N/A UPPER N/A

EXTINGUISHING MEDIA

MATERIAL IS NONFLAMMABLE. USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE FIGHTING PROCEDURES

THOUGH NOT FLAMMABLE ITSELF, OXYGEN VIGOROUSLY ACCELERATES COMBUSTION. IF POSSIBLE, SHUT OFF OXYGEN GAS AND REMOVE CYLINDERS FROM FIRE AREA OR COOL WITH WATER TO AVOID EXCESSIVE PRESSURE BUILD UP.

UNUSUAL FIRE AND EXPLOSION HAZARD

MATERIALS WHICH DO NOT BURN IN AIR MAY BURN IN AN OXYGEN-ENRICHED ATMOSPHERE WHERE THE OXYGEN CONTENT EXCEEDS 21%. OXYGEN MAY FORM EXPLOSIVE COMPOUNDS WHEN EXPOSED TO COMBUSTIBLE MATERIALS OR OIL, GREASE, AND OTHER HYDROCARBON MATERIALS. PRESSURE CAN BUILD UP DUE TO HEAT AND CYLINDER MAY EXPLODE IF PRESSURE RELIEF DEVICES SHOULD FAIL TO

RELIEVE PRESSURE.

V - H E A L T H H A Z A R D D A T A

THRESHOLD LIMIT VALUE	NONE ESTABLISHED
UNUSUAL CHRONIC TOXICITY	*SEE OVEREXPOSURE SECTION*
CARCINOGENICITY	NOT LISTED BY IARC, NTP, OSHA
ROUTES OF EXPOSURE	INHALATION

EFFECTS OF OVEREXPOSURE

BREATHING 80% OR MORE OXYGEN AT ATMOSPHERIC PRESSURE FOR MORE THAN A FEW HOURS MAY CAUSE NASAL STUFFINESS, COUGH, SORE THROAT, CHEST PAIN AND BREATHING DIFFICULTY. BREATHING OXYGEN AT HIGHER PRESSURE INCREASES THE LIKELIHOOD OF ADVERSE EFFECTS WITHIN A SHORTER TIME PERIOD. EXPOSURE TO OXYGEN AT HIGHER PRESSURES FOR PROLONGED PERIODS HAS BEEN FOUND TO AFFECT VISION, NEUROMUSCULAR COORDINATION AND ATTENTIVE POWERS.

TOXICOLOGICAL PROPERTIES:

AT NORMAL CONCENTRATION AND PRESSURE, OXYGEN POSES NO TOXICITY HAZARDS. HOWEVER, AT ELEVATED CONCENTRATIONS AND PRESSURES, OXYGEN MAY CAUSE ADVERSE EFFECTS (SEE ABOVE).

EMERGENCY AND FIRST AID PROCEDURES

REDUCE OXYGEN PRESSURES TO 1 ATM AND/OR MOVE VICTIM INTO FRESH AIR.

RESCUE PERSONNEL SHOULD BE AWARE OF EXTREME FIRE HAZARDS ASSOCIATED WITH OXYGEN-ENRICHED ATMOSPHERES.

V I - R E A C T I V I T Y D A T A

STABILITY STABLE

CONDITIONS TO AVOID

NONE.

INCOMPATABILITY (MATERIALS TO AVOID)

OXYGEN REACTS EXPLOSIVELY WITH ETHERS, ALCOHOLS, AND HYDROCARBON MATERIALS. KEEP OXYGEN CONTAINERS FREE OF OIL AND/OR GREASE.

HAZARDOUS DECOMPOSITION PRODUCTS

NONE.

HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID

NONE.

V I I - S P I L L O R L E A K P R O C E D U R E S

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

EVACUATE ALL UNNECESSARY PERSONNEL FROM AFFECTED AREA. SHUT OFF SOURCE OF OXYGEN IF POSSIBLE. VENTILATE AREA TO PREVENT OXYGEN-ENRICHED ATMOSPHERE. REMOVE SOURCES OF HEAT OR IGNITION. IF LEAKING FROM CONTAINER OR VALVE, CONTACT THE CLOSEST BIG THREE INDUSTRIES LOCATION, OR YOUR SUPPLIER.

WASTE DISPOSAL METHOD

DO NOT ATTEMPT TO DISPOSE OF RESIDUAL OR UNUSED QUANTITIES. RETURN TO YOUR SUPPLIER FOR DISPOSAL. FOR EMERGENCY DISPOSAL, SECURE THE CYLINDER AND BLOW DOWN SLOWLY TO THE ATMOSPHERE IN A WELL-VENTILATED AREA OR OUTDOORS.

VIII - SPECIAL PROTECTIVE INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)

NONE.

VENTILATION

NATURAL OR MECHANICAL WHERE GAS IS PRESENT -- *SEE NOTES*

PROTECTIVE GLOVES

IF USED, MUST BE CLEAN AND GREASE FREE

EYE PROTECTION

SAFETY GLASSES ARE RECOMMENDED WHEN HANDLING HIGH PRESSURE CYLINDERS.

OTHER PROTECTIVE EQUIPMENT

SAFETY SHOES WHEN HANDLING CYLINDERS.

********** SECTION NOTES **********

LOCAL EXHAUST: SUFFICIENT TO PREVENT OXYGEN-ENRICHED ATMOSPHERES OF OVER 21% OXYGEN.

IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

STORE AND USE WITH ADEQUATE VENTILATION. OXGYEN IS HEAVIER THAN AIR AND LEAKING GAS COULD ACCUMULATE IN LOW AREAS OR CONFINED SPACES CAUSING AN OXYGEN-ENRICHED ATMOSPHERE. CYLINDERS SHOULD BE STORED UPRIGHT WITH VALVE PROTECTION CAP IN PLACE AND FIRMLY SECURED TO PREVENT FALLING OR BEING KNOCKED OVER. PROTECT CYLINDERS FROM PHYSICAL DAMAGE; DO NOT DRAG, ROLL, SLIDE, OR DROP. USE A SUITABLE HAND TRUCK FOR CYLINDER MOVEMENT. DO NOT ALLOW THE TEMPERATURE WHERE CYLINDERS ARE STORED TO EXCEED 125 F (52 C). DO NOT STORE OXYGEN CLOSER THAN 20 FEET FROM FLAMMABLE OR COMBUSTIBLE MATERIALS. KEEP CYLINDERS FREE FROM OIL AND GREASE.

D.O.T. LABELING

OXYGEN --- YELLOW LABEL

VALVE CONNECTION

CGA 540 OR CGA 870 (PIN INDEXED)

OTHER PRECAUTIONS

ALL GAUGES, VALVES, REGULATORS, PIPING AND EQUIPMENT TO BE USED IN OXYGEN SERVICE MUST BE CLEANED FOR OXYGEN SERVICE IN ACCORDANCE WITH CGA PAMPHLET G-4.1. OXYGEN IS NOT TO BE USED AS A SUBSTITUTE FOR COMPRESSED AIR. NEVER STRIKE A WELDING ARC ON ANY COMPRESSED GAS CYLINDER. REFILLING CYLINDERS WITHOUT THE CONSENT OF THE CYLINDER OWNER IS A VIOLATION OF FEDERAL LAW (49 CFR).

DOT PLACARD: OXYGEN

DOT PROPER SHIPPING NAME: OXYGEN, COMPRESSED

MISCELLANEOUS INFORMATION:

FURTHER INFORMATION ABOUT OXYGEN CAN BE FOUND IN THE FOLLOWING PAMPHLETS PUBLISHED BY:

THE COMPRESSED GAS ASSOCIATION (CGA)
1235 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VA 22202
(703) 979-4341

G-4.3: "COMMODITY SPECIFICATION FOR OXYGEN"
G-4: "OXYGEN"
G-4.1: "CLEANING EQUIPMENT FOR OXYGEN SERVICE"
P-1: "SAFE CLEANING OF COMPRESSED GASES IN CONTAINERS"
P-14: "ACCIDENT PREVENTION IN OXYGEN-RICH AND OXYGEN-DEFICIENT ATMOSPHERES"
SB-8: "USE OF OXY-FUEL GAS WELDING AND CUTTING APPARATUS"
AV-8: "CHARACTERISTICS AND SAFE HANDLING OF CRYOGENIC LIQUID AND GASEOUS OXYGEN"

NFPA RATINGS:
HEALTH: 0
FLAMMABILITY: 0
REACTIVITY: 0

HMIS RATINGS:
HEALTH: 0
FLAMMABILITY: 0
REACTIVITY: 0

CERCLA RATINGS:
HEALTH: 0
FIRE: 0
REACTIVITY: 0
PERSISTANCE: 3

LISTED IN TSCA INVENTORY: YES

AIR LIQUIDE AMERICA CORPORATION
P. O. BOX 3047
HOUSTON, TX 77253

M A T E R I A L S A F E T Y D A T A S H E E T

STILL CURRENT
5-1-96 ALAC/RLP

I - G E N E R A L I N F O R M A T I O N

PRODUCT NAME NITROGEN

EMERGENCY TELEPHONE NO. 713-868-0302
MANUFACTURERS NAME AIR LIQUIDE AMERICA CORP.
TRADE NAME/SYNONYMS NITROGEN; NITROGEN, NF
CHEMICAL NAME AND SYNONYMS
NITROGEN
REVISION DATE: 08/24/89 PRODUCT ID. UN 1066 FORMULA N2
CHEMICAL FAMILY INERT GAS CAS NUMBER 7727-37-9

********** SECTION NOTES **********

MSDS INFORMATION NUMBER: (713) 896-2140

I I - H A Z A R D O U S I N G R E D I E N T S

HAZARDOUS MIXTURES OF LIQUIDS AND GASES	O/O	TLV
NITROGEN	100	**

** NONE ESTABLISHED

I I I - P H Y S I C A L D A T A

BOILING POINT -320.4F (-195.8C) @ 1 ATM
SPECIFIC GRAVITY (AIR = 1): 0.967 @ 70 F (21.1C) & 1 ATM
VAPOR PRESSURE N/A
PERCENT VOLATILE BY VOLUME (O/O) N/A (GAS)
DENSITY 0.07245 LB/CU FT
@ 70 F (21.1 C) & 1 ATM
EVAPORATION RATE N/A (GAS)
SOLUBILITY IN WATER 2.33SCC/100CC H2O @ 32 F (0 C)
MATERIAL AT NORMAL CONDITION GAS
EXPANSION RATIO (LIQUID TO GAS) N/A (GAS)

APPEARANCE AND COOR

COLORLESS, ODORLESS, TASTELESS GAS

I V - F I R E A N D E X P L O S I O N H A Z A R D D A T A

FLASH POINT N/A
FLASH POINT (METHOD USED)
FLAMMABILITY LIMITS IN AIR (O/O BY VOL) LOWER N/A UPPER N/A

EXTINGUISHING MEDIA

MATERIAL IS NONFLAMMABLE. NITROGEN NEITHER BURNS NOR SUPPORTS COMBUSTION. USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE FIGHTING PROCEDURES

NONE. NITROGEN WILL ACT AS A SIMPLE ASPHYXIANT IF IT DISPLACES OXYGEN. IF POSSIBLE, REMOVE NITROGEN CYLINDERS FROM FIRE AREA OR COOL WITH WATER TO AVOID EXCESSIVE PRESSURE BUILDUP. SELF-CONTAINED BREATHING APPARATUS MAY BE REQUIRED FOR RESCUE WORKERS.

UNUSUAL FIRE AND EXPLOSION HAZARD

PRESSURE CAN BUILD UP DUE TO HEAT AND CYLINDER MAY EXPLODE IF PRESSURE RELIEF DEVICES SHOULD FAIL TO RELIEVE PRESSURE.

AUTOIGNITION TEMPERATURE: N/A

M A T E R I A L S A F E T Y D A T A S H E E T

PRODUCT NAME NITROGEN

ELECTRICAL CLASSIFICATION: NONHAZARDOUS

V - H E A L T H H A Z A R D D A T A

THRESHOLD LIMIT VALUE	NONE ESTABLISHED
UNUSUAL CHRONIC TOXICITY	*SEE OVEREXPOSURE SECTION*
CARCINOGENICITY	NOT LISTED BY IARC, NTP, OSHA
ROUTES OF EXPOSURE	INHALATION

EFFECTS OF OVEREXPOSURE

NITROGEN IS NONTOXIC, BUT MAY CAUSE SUFFOCATION BY DISPLACING THE OXYGEN IN THE AIR. EXPOSURE TO OXYGEN-DEFICIENT ATMOSPHERES MAY CAUSE DIZZINESS, NAUSEA, VOMITING, DIMINISHED MENTAL ALERTNESS, LOSS OF CONSCIOUSNESS, AND DEATH. IT SHOULD BE RECOGNIZED THAT COLLAPSE AND ASPHYXIATION MAY OCCUR WITHOUT EXPERIENCING ANY OF THE ABOVE SYMPTOMS.

TOXICOLOGICAL PROPERTIES:

NITROGEN IS A SIMPLE ASPHYXIANT.

EMERGENCY AND FIRST AID PROCEDURES

PERSONS SUFFERING FROM LACK OF OXYGEN SHOULD BE MOVED INTO FRESH AIR. IF VICTIM IS NOT BREATHING, ADMINISTER ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. OBTAIN PROMPT MEDICAL ATTENTION.

SELF-CONTAINED BREATHING APPARATUS MAY BE REQUIRED FOR RESCUE WORKERS.

V I - R E A C T I V I T Y D A T A

STABILITY STABLE

CONDITIONS TO AVOID

NONE.

INCOMPATABILITY (MATERIALS TO AVOID)

NONE.

HAZARDOUS DECOMPOSITION PRODUCTS

NONE.

HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID

NONE.

V I I - S P I L L O R L E A K P R O C E D U R E S

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

M A T E R I A L S A F E T Y D A T A S H E E T

PRODUCT NAME NITROGEN

EVACUATE ALL UNNECESSARY PERSONNEL FROM AFFECTED AREA. SHUT OFF SOURCE OF NITROGEN IF POSSIBLE. VENTILATE ENCLOSED AREAS OR REMOVE CYLINDERS TO AN OUTDOOR LOCATION TO PREVENT FORMATION OF OXYGEN-DEFICIENT ATMOSPHERES. IF LEAKING FROM CONTAINER OR VALVE, CONTACT THE CLOSEST BIG THREE INDUSTRIES LOCATION, OR YOUR SUPPLIER.

WASTE DISPOSAL METHOD

DO NOT ATTEMPT TO DISPOSE OF RESIDUAL OR UNUSED QUANTITIES. RETURN TO YOUR SUPPLIER FOR DISPOSAL. FOR EMERGENCY DISPOSAL, SECURE CYLINDER AND VENT SLOWLY TO THE ATMOSPHERE IN A WELL-VENTILATED AREA OR OUTDOORS.

VIII - SPECIAL PROTECTIVE INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)

USE SELF-CONTAINED BREATHING APPARATUS OR POSITIVE PRESSURE AIR LINE WITH MASK IN OXYGEN-DEFICIENT ATMOSPHERES. RESPIRATORS WILL NOT FUNCTION.

VENTILATION

SEE NOTES

PROTECTIVE GLOVES

N/A

EYE PROTECTION

SAFETY GLASSES ARE RECOMMENDED WHEN HANDLING HIGH PRESSURE CYLINDERS.

OTHER PROTECTIVE EQUIPMENT

SAFETY SHOES WHEN HANDLING CYLINDERS.

********** SECTION NOTES **********

ADEQUATE TO AVOID LOWERING OXYGEN CONTENT TO BELOW 19.5 % (OXGYEN-DEFICIENT ATMOSPHERE).

LOCAL EXHAUST: YES
MECHANICAL: YES

IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

STORE AND USE WITH ADEQUATE VENTILATION. CYLINDERS SHOULD BE STORED UPRIGHT WITH VALVE PROTECTION CAP IN PLACE AND FIRMLY SECURED TO PREVENT FALLING OR BEING KNOCKED OVER. PROTECT CYLINDERS FROM PHYSICAL DAMAGE; DO NOT DRAG, ROLL, SLIDE, OR DROP. USE A SUITABLE HAND TRUCK FOR CYLINDER MOVEMENT. DO NOT ALLOW THE TEMPERATURE WHERE CYLINDERS ARE STORED TO EXCEED 125 F (52 C).

D.O.T. LABELING

NONFLAMMABLE GAS - GREEN LABEL

VALVE CONNECTION

580

OTHER PRECAUTIONS

NEVER STRIKE A WELDING ARC ON ANY COMPRESSED GAS CYLINDER. REFILLING CYLINDERS WITHOUT THE CONSENT OF THE CYLINDER OWNER IS A VIOLATION OF FEDERAL LAW (49 CFR).

DOT PLACARD: NONFLAMMABLE GAS

DOT PROPER SHIPPING NAME: NITROGEN, COMPRESSED

MISCELLANEOUS INFORMATION:

FURTHER INFORMATION ABOUT NITROGEN CAN BE FOUND IN THE FOLLOWING PAMPHLETS PUBLISHED BY:

THE COMPRESSED GAS ASSOCIATION (CGA)
1235 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VA 22202
(703) 979-4341

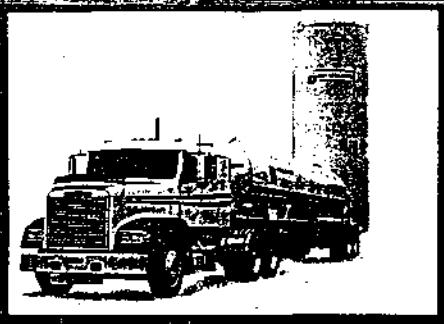
G-10.1: "COMMODITY SPECIFICATION FOR NITROGEN"
P-1: "SAFE HANDLING OF COMPRESSED GASES IN CONTAINERS"
P-9: "THE INERT GASES ARGON, NITROGEN, AND HELIUM"
P-14: "ACCIDENT PREVENTION IN OXYGEN-RICH AND OXYGEN-DEFICIENT ATMOSPHERES"
SB-2: "OXYGEN DEFICIENT ATMOSPHERES"

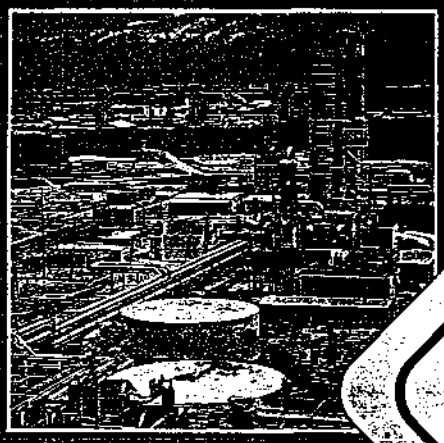
NFPA RATINGS:
HEALTH: 0
FLAMMABILITY: 0
REACTIVITY: 0

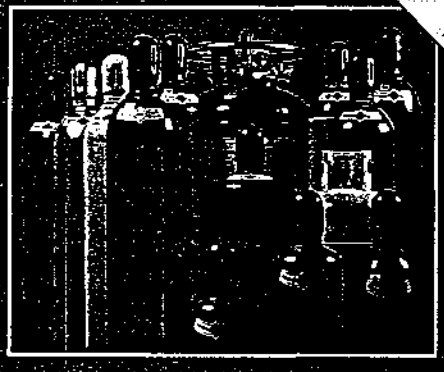
HMIS RATINGS:
HEALTH: 0
FLAMMABILITY: 0
REACTIVITY: 0

CERCLA RATINGS:
HEALTH: 0
FIRE:0
REACTIVITY: 0
PERSISTANCE: 3

LISTED IN TSCA INVENTORY: YES







SAFETY PRECAUTIONS

HOW TO SAFELY HANDLE AND USE LIQUEFIED AND COMPRESSED GASES

AIR LIQUIDE

HER 01013

SAFETY PRECAUTIONS

Oxygen, nitrogen, argon, helium, compressed air, carbon dioxide, nitrous oxide, hydrogen, acetylene, and specialty gases have properties that can cause serious accidents, injuries, and even death if proper precautions and safety practices are not followed. Always use information found in Material Safety Data Sheets (MSDS) and/or applicable safety standards as a source of information [illegible]

THIS SAFETY PRECAUTION PAMPHLET IS OFFERED SOLELY FOR YOUR INFORMATION, CONSIDERATION AND INVESTIGATION. THE COMPANY PROVIDES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE DATA CONTAINED HEREIN.

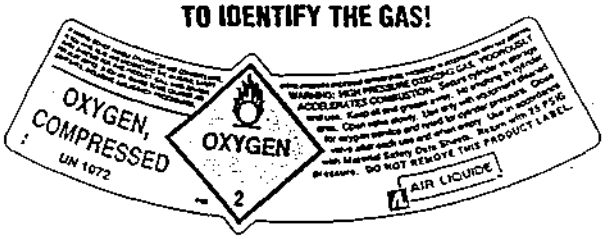
THE FOLLOWING PROCEDURES SHOULD BE OBSERVED WHEN HANDLING COMPRESSED GAS CYLINDERS OR LIQUEFIED GAS CONTAINERS.

1

Read the label on all cylinders or containers before use to identify their contents. If the label is not legible or is missing, do not assume that the cylinder contains a particular gas, but return the cylinder to the gas supplier.

NEVER RELY ON THE COLOR OF THE CYLINDER TO IDENTIFY ITS CONTENTS.

READ THE LABEL TO IDENTIFY THE GAS!



2

Observe all warnings and safety precautions set forth on the cylinder label.

3

Always secure cylinders in storage and use. Never remove the valve protection cap until the cylinder is secured (chained, tied, etc.) and ready for use.

W A R N I N G

IF A CYLINDER IS KNOCKED OVER AFTER THE CAP IS REMOVED, THE VALVE COULD BE BROKEN OFF CAUSING THE CYLINDER TO BE PROPELLED VIOLENTLY.

4 *Never attempt to lift a cylinder by the valve protection cap.*

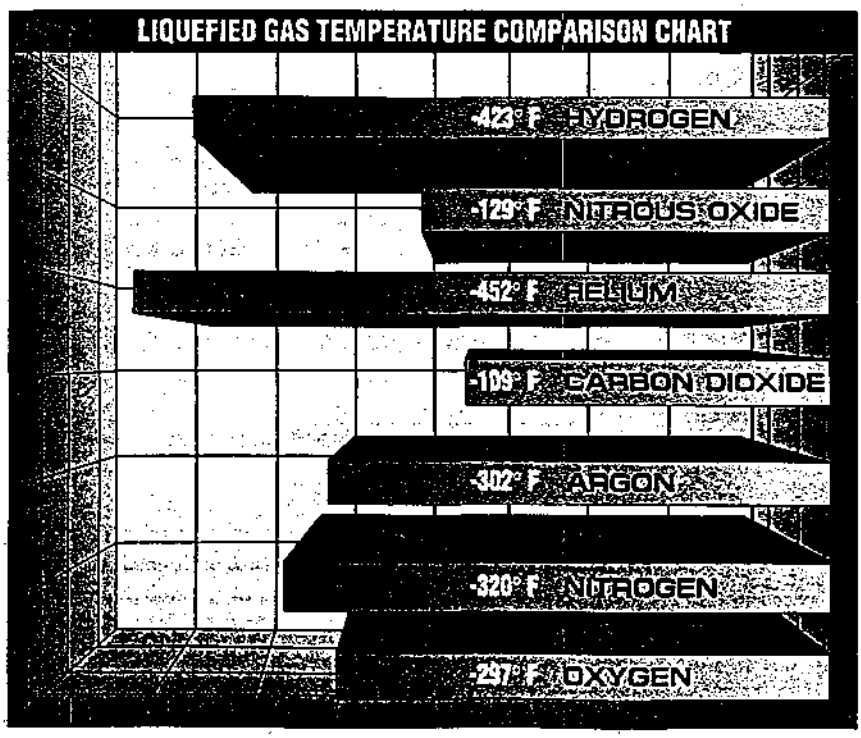
5 *Always use a pressure-reducing regulator when withdrawing any gaseous product from a cylinder or other high pressure source. To minimize the chance of injury, stand to one side of the regulator when opening the cylinder valve.*

6 *Never use an adaptor to connect a cylinder valve to a regulator or other piece of equipment. Specific valve outlet connections have been designed for most gases to prevent misuse and contamination. For further information, see CGA (Compressed Gas Association) / ANSI (American National Standards Institute) pamphlet V-1, "Compressed Cylinder Outlet and Inlet Connections".*

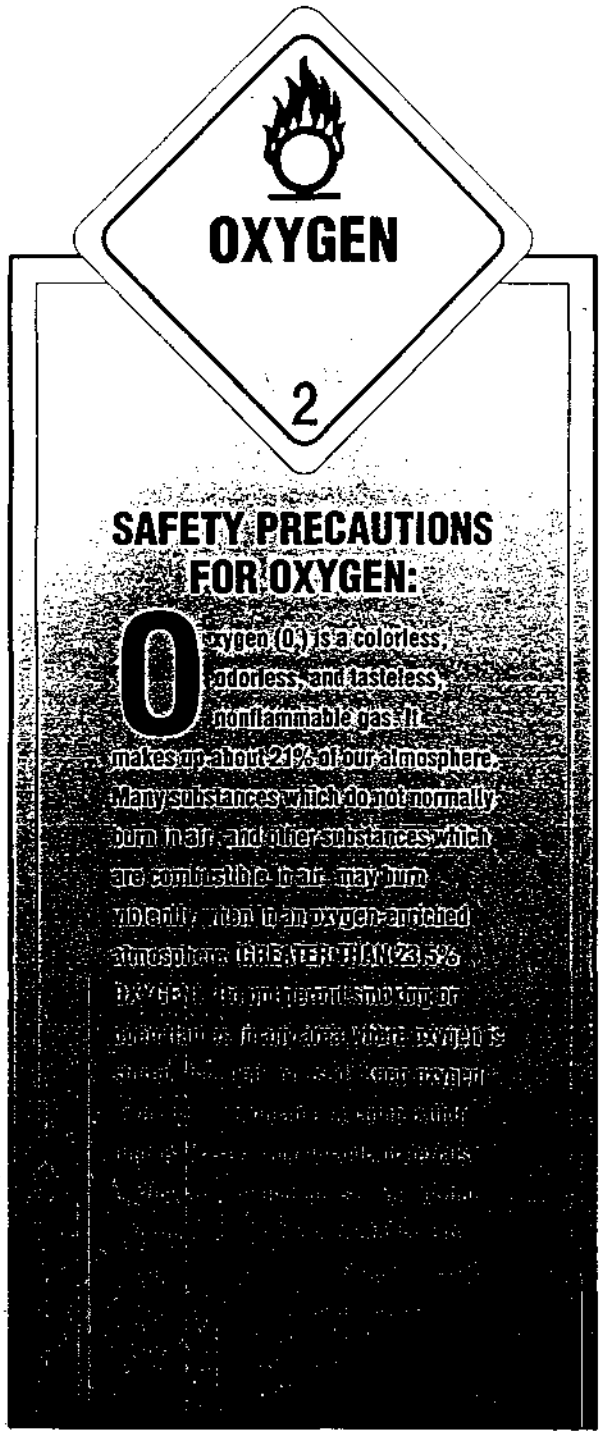
7 *Never attempt to transfer any gas from one cylinder to another or to mix any gases in a cylinder.*

8 *Containers of liquefied compressed gases such as oxygen, nitrogen, argon, helium, hydrogen, carbon dioxide, and nitrous oxide must be kept in an upright position and secured to prevent them from being knocked over.*

9 *Always use a cart when moving cylinders or liquefied gas containers.*



10 *Liquefied gases are extremely cold and these liquids or their cold "boil-off" vapors can* ***cause cold contact burns or "frostbite". In addition, many materials such as carbon steel will become brittle and may fracture when exposed to these cold temperatures. Piping for these cold liquids must be designed for extreme cold.***



W A R N I N G

WHILE OXYGEN IS NONFLAMMABLE, IT SUPPORTS AND CAN GREATLY ACCELERATE COMBUSTION. KEEP COMBUSTIBLES AND IGNITION SOURCES AWAY FROM WHERE OXYGEN IS BEING USED OR STORED.

KEEP ALL SURFACES WHICH MAY COME IN CONTACT WITH OXYGEN CLEAN TO PREVENT IGNITION.

Even normal industrial soot and dirt can constitute a combustion hazard in the presence of oxygen. Do not place liquid oxygen equipment on asphalt or on any surface which may have oil or grease deposits. If liquid oxygen is spilled, do not walk on or roll equipment over the spill. Use cleaning agents which will not leave organic deposits on the cleaned surfaces. In handling equipment which may come in contact with oxygen, use only clean, lint- free gloves or hands washed clean of oil. Never **lubricate oxygen valves, regulators, gauges, or fittings with oil, grease, or other lubricants that are not oxygen compatible.** Check with your lubricant manufacturer or oxygen supplier for a source of oxygen compatible lubricants.

W A R N I N G

LIQUID OXYGEN IS EXTREMELY COLD (-297.0 °F), AND AS A LIQUID OR COLD GAS MAY CAUSE SEVERE FROSTBITE TO THE EYES OR SKIN.

Do not touch frosted pipes or valves. If accidental eye or skin contact with liquid oxygen occurs, consult a physician at once. **Do not rub frozen body parts, as tissue damage may result.** Remove any clothing that may restrict circulation to the frozen area. As soon as practical, place the affected part of the body in a warm water bath which has a temperature not to exceed 105°F (40°C). Never use dry heat.

PROTECT EYES AND SKIN.

Always handle liquid so that it will not splash or spill. Protect your eyes with safety goggles or face shield, and cover the skin to prevent contact with the liquid or cold gas. Clean, protective gloves that can be quickly and easily removed, and long sleeves are recommended for arm protection. Cuffless trousers should be worn outside of boots or work shoes to shed spilled liquid. If clothing should be splashed with liquid oxygen or otherwise saturated with oxygen gas, it should not be considered safe to wear for at least 30 minutes, since it can be easily ignited while the concentrated oxygen remains.

LIQUID-TO-GAS EXPANSION

Cryogenic liquids produce large quantities of gas when they vaporize. Liquid oxygen will expand at a ratio of 1:860, liquid to gas. If liquid oxygen is trapped in a sealed container or piping, it will vaporize producing enormous pressures which could cause the container to rupture violently if not protected by a pressure relief device.

VAPOR CLOUD OR FOG

Cryogenic liquids and their "boil-off" vapors are extremely cold and have a built-in warming property that appears whenever they are exposed to the atmosphere. The cold "boil-off" gases condense the moisture in the air, creating a highly visible fog or vapor cloud. This fog normally extends over a larger area than the vaporizing gas.

If a large vapor cloud forms after a liquid spill, you should avoid this cloud because of possible oxygen enriched atmospheres or reduced visibility. In addition, all sources of ignition should be shut off in the path of the oxygen vapor cloud, if possible.

Small fog areas may appear during liquid transfer as the cold piping condenses moisture in the surrounding air.

STORE OXYGEN CYLINDERS AND LIQUEFIED OXYGEN CONTAINERS IN ACCORDANCE WITH APPLICABLE SAFETY CODES.

Oxygen in storage must be separated from flammable liquids or gases and combustible materials (especially oil or grease), a minimum distance of 20 feet unless separated by a noncombustible barrier at least 5 feet high and having a fire resistance rating of at least one-half hour. For more information, see NFPA Standard No. 50, "Bulk Oxygen Systems At Consumer Sites".

MAINTAIN ADEQUATE VENTILATION.

Adequate ventilation must be provided to prevent accumulation of oxygen and minimize combustion hazards in areas where oxygen is used and stored.

CONTAINERS, EQUIPMENT, AND REPLACEMENT PARTS MUST BE SUITABLE FOR OXYGEN SERVICE.

Use only equipment, cylinders, containers and apparatus designed and approved for use with oxygen. Many materials, especially some non-metallic gaskets and seals, constitute a combustion hazard when in oxygen service, although they may be acceptable for use with other gases. Make no substitutions for recommended equipment, and be sure all replacement parts are compatible with oxygen and cleaned for oxygen service. Keep repair parts in sealed, clean plastic bags until ready for use.

REGULATORS

Before attaching a regulator to a cylinder, visually inspect the cylinder valve outlet very carefully for traces of dirt, dust, oil or grease. Remove dirt and dust with a clean cloth, but if oil or grease is detected, do not use the cylinder; return it to your supplier. Before attaching the regulator to the cylinder valve, crack the cylinder valve momentarily to blow out any dust or dirt that might have accumulated in the valve outlet. Visually inspect the regulator and the inlet connection to ensure that they are free of dirt, oil, grease or other hydrocarbon-type contaminants. These contaminants may ignite and burn violently when the cylinder valve is opened. Dirt and dust should be removed with a clean cloth. However, oil and grease cannot be easily removed, and the regulator should be returned to an authorized service facility for proper cleaning. Connect the regulator to the valve, back out the pressure-adjusting screw until it turns freely, open the cylinder valve slowly until maximum pressure is indicated on the high pressure gauge, then open the cylinder valve all the way to eliminate possible leaks through the packing. **To minimize the chance of injury, stand to one side of the regulator when opening the cylinder valve.**

W A R N I N G

REGULATORS WHICH HAVE BEEN USED WITH FLAMMABLE GASES SHOULD NEVER BE USED FOR OXYGEN SERVICE UNLESS CLEANED BY AUTHORIZED PERSONNEL.

OBSERVE ALL APPLICABLE SAFETY CODES WHEN INSTALLING OXYGEN EQUIPMENT.

Follow the recommendations of the NFPA Standard No. 50, "Bulk Oxygen Systems at Consumer Sites", NFPA Standard No. 51, "Oxygen-Fuel-Gas Systems for Cutting and Welding", American National Standards Institute Pamphlet No. Z49.1, "Safety In Welding and Cutting", and with all local safety codes when installing oxygen equipment or oxygen piping.

OXYGEN FOR MEDICAL USE

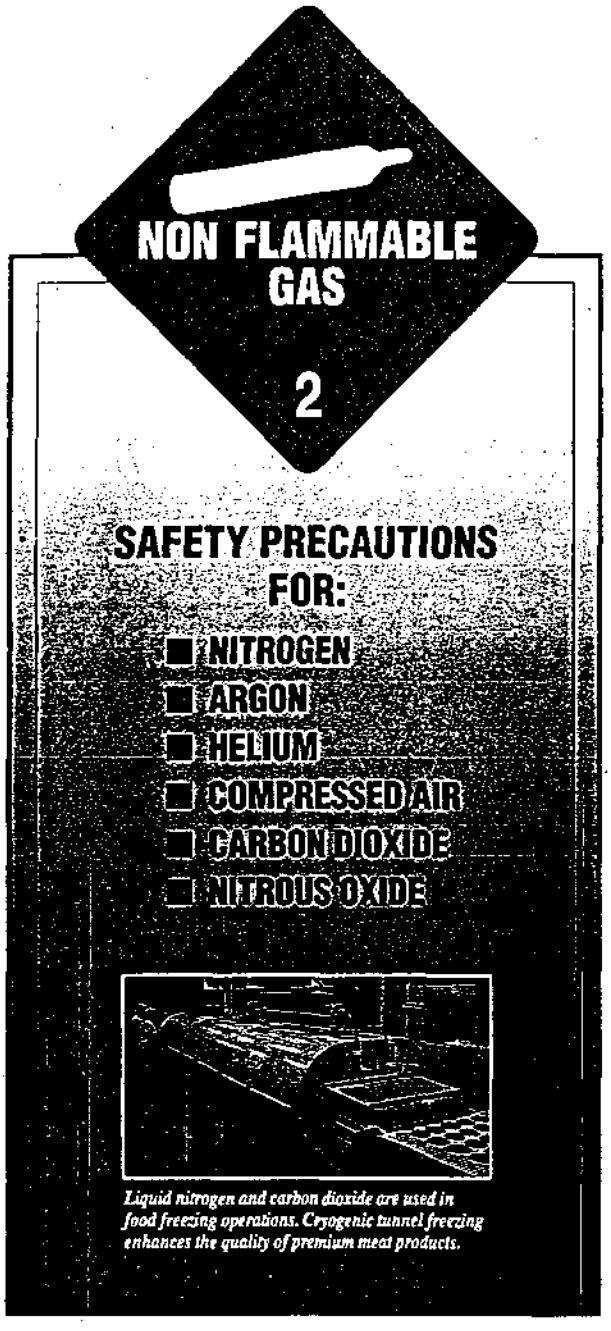
Oxygen should be used for medical use only if it is labeled: **"Oxygen U.S.P."**, and it is administered by qualified persons; and, except in emergencies, under doctor's prescription.

For further information about medical gas systems, consult NFPA Standard No. 99, "Health Care Facilities".

Oxygen should never be substituted for breathing air when air supplied respiratory protection is used since regulators used in this service may contain substances which are not compatible with oxygen and may result in an explosion.

IF IT IS NECESSARY TO DISPOSE OF WASTE GAS OR LIQUID, EXERCISE CAUTION.

Gaseous oxygen should be released only outdoors away from personnel, combustible materials, and sources of ignition. Liquid oxygen should be dumped into an outdoor pit filled with clean, grease and oil-free gravel, where it will evaporate safely.



Liquid nitrogen and carbon dioxide are used in food freezing operations. Cryogenic tunnel freezing enhances the quality of premium meat products.

NITROGEN, ARGON, AND HELIUM SAFETY PRECAUTIONS

Nitrogen (N_2), argon (Ar), and helium (He) are inert, colorless, odorless, tasteless and nonflammable gases. The atmosphere that we breathe contains 21% oxygen, 78% nitrogen, 1% argon and trace amounts of other gases such as helium.

W A R N I N G

NITROGEN, ARGON, AND HELIUM ARE NONTOXIC, BUT THEY CAN CAUSE ASPHYXIATION AND DEATH IN CONFINED, POORLY VENTILATED AREAS BY DISPLACING THE OXYGEN WHICH IS NECESSARY TO SUSTAIN LIFE.

Atmospheres which do not contain enough oxygen for breathing (at least 19.5%) can cause dizziness, unconsciousness, or even death.

Nitrogen, argon, and helium cannot be detected by the human senses and will be inhaled like air. If adequate ventilation is not provided, these gases may displace normal air without warning. Store containers outdoors or in other well-ventilated areas. **Never enter any tank, pit, or other confined area where these gases may be present until purged with air and tested for a breathable atmosphere (at least 19.5% oxygen) using an oxygen analyzer.**

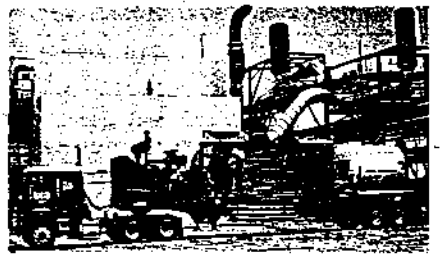
W A R N I N G

LIQUID NITROGEN (- 320.4 °F), ARGON (- 302.5 °F), AND HELIUM (- 452.0 °F) ARE EXTREMELY COLD, AND AS LIQUIDS OR COLD GASES CAN CAUSE SEVERE FROSTBITE TO THE EYES OR SKIN.

Do not touch frosted pipes or valves. If accidental eye or skin contact with cryogenic liquids occur, consult a physician at once. **Do not rub frozen body parts, as tissue damage may result.** Remove any clothing that may restrict circulation to the frozen area. As soon as practical, place the affected part of the body in a warm water bath which has a temperature not to exceed 105°F (40°C). Never use dry heat.

PROTECT EYES AND SKIN.

Always handle liquid so that it will not splash or spill. Protect your eyes with safety goggles or face shield, and cover the skin to prevent contact with the liquid or cold gas. Protective gloves that can be quickly and easily removed and long sleeves are recommended for arm protection. Wear cuffless trousers outside boots or over work shoes to shed spilled liquid.



High pressure mobile units respond to special applications for nitrogen and oxygen.

LIQUID-TO-GAS EXPANSION

Cryogenic liquids produce large quantities of gas when they vaporize. Liquid nitrogen will expand at a ratio of 1:696 liquid to gas, liquid argon will expand at a ratio of 1:842 liquid to gas, and liquid helium will expand at a ratio of 1:745 liquid to gas. If liquid nitrogen, argon or helium is trapped in a sealed container or piping, it will vaporize producing enormous pressures which could cause the container to rupture violently if not protected by a pressure relief device.

VAPOR CLOUD OR FOG

Cryogenic liquids and their "boil-off" vapors are extremely cold and have a built-in warning property that appears whenever they are exposed to the atmosphere. The cold "boil-off" gases condense the moisture in the air, creating a highly visible fog or vapor cloud. This fog normally extends over a larger area than the vaporizing gas.

If a large vapor cloud forms after a liquid spill, you should avoid this cloud because of possible oxygen deficient atmospheres or reduced visibility.

Small fog areas may appear during liquid transfer as the cold piping condenses moisture in the surrounding air.

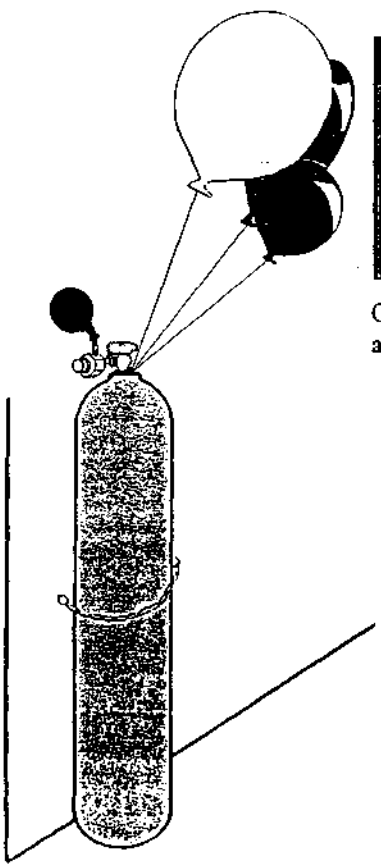
LIQUID HELIUM SPECIAL PRECAUTIONS

The extremely low temperature of liquid helium (- 452.0 °F) can solidify any gas including air. Such solidified gases can plug pressure-relief passages and devices making them ineffective in relieving excess pressure from evaporating liquid. Always store and handle liquid helium under positive pressure and in closed systems to prevent infiltration and solidification of air or other gases.

Keep exterior surfaces of liquid helium equipment clean. Oxygen can condense from the air on exposed liquid helium or cold-gas equipment surfaces, such as vaporizers and piping. To prevent the possible ignition of grease, oil, or other combustible materials with the condensed oxygen, keep these surfaces clean.

IF IT IS NECESSARY TO DISPOSE OF WASTE GAS OR LIQUID, EXERCISE CAUTION.

Gaseous nitrogen, argon, or helium should be released only in an outdoor area. Liquid nitrogen, argon or helium should be released into an outdoor pit filled with clean, grease and oil-free gravel, where it will evaporate rapidly and safely.



HELIUM BALLOON WARNING

HELIUM BALLOONS AND BALLOON FILLING EQUIPMENT ARE OFTEN MISUSED IN AN ATTEMPT TO ALTER VOICE CHARACTERISTICS BY INHALING HELIUM TO TALK LIKE *"DONALD DUCK"*.

THIS IS AN EXTREMELY DANGEROUS PROCEDURE WHICH HAS RESULTED IN DEATHS THROUGH SUFFOCATION AND/OR LUNG DAMAGE.

Observe the following precautions when handling helium cylinders for balloon filling. **Don't let an accident spoil the fun of using helium filled balloons.**

- Read and follow the safety precautions that appear on the cylinder label.
- Use only a regulator which is designed for balloon filling.
- Store and use helium cylinders in a well ventilated area, and transport cylinders only in well ventilated vehicles. **Helium gas is odorless and non-toxic, but can cause suffocation by displacing the oxygen you breathe.**
- Never remove the cylinder valve protection cap until the cylinder is secured (chained, tied, etc.) in an upright position and ready for use.
- Do not breathe helium from the cylinders, filling regulators or from helium filled balloons.
- Never allow children to operate balloon filling equipment.
- Close the cylinder valve after each use and when empty.
- Never leave the cylinder unattended with the regulator attached.

COMPRESSED AIR SAFETY PRECAUTIONS

Compressed air is a colorless, odorless, tasteless and nonflammable gas that is produced by compression and filtration of atmospheric air or by synthetically mixing 21% oxygen and 79% nitrogen.

W A R N I N G

COMPRESSED AIR IS NONFLAMMABLE; HOWEVER, IT WILL SUPPORT COMBUSTION. WHEN UNDER PRESSURE, IT CAN EVEN ACCELERATE COMBUSTION.

BREATHING AIR

When using compressed air for breathing, ensure that you have a source of air (cylinder or compressor) that meets or exceeds the specification for CGA "Grade D" air that is required by OSHA.

Fire fighters using breathing air in self-contained breathing apparatus (SCBA).

Oxygen should never be substituted for breathing air when air-supplied respiratory protection is used since regulators used in this service may contain substances which are not compatible with oxygen and may result in an explosion.

AIR FOR MEDICAL USE

If air is used for medical purposes, then you must use a medical grade of air "Compressed Air U.S.P.".

SPECIAL PRECAUTIONS FOR COMPRESSED AIR

Compressed air is often used to power pneumatic tools. **Under no circumstances should oxygen be substituted for air to power tools since these tools contain lubricants which are not oxygen compatible and could cause an explosion resulting in severe injury or death.**

CARBON DIOXIDE SAFETY PRECAUTIONS

Carbon dioxide (CO_2) is a colorless, odorless and nonflammable gas with a slightly acidic taste.

W A R N I N G

CARBON DIOXIDE CAN CAUSE ASPHYXIATION AND DEATH IN CONFINED, POORLY VENTILATED AREAS BY DISPLACING THE OXYGEN WHICH IS NECESSARY TO SUSTAIN LIFE.

Concentrations of 10% carbon dioxide or greater will cause unconsciousness or death, without regard to oxygen concentration. In addition to the asphyxiation hazard, carbon dioxide acts as a stimulant and depressant on the central nervous system. At lower concentrations, increases in heart rate and blood pressure have been noted, and labored breathing, headaches, and dizziness may occur if exposure is prolonged, regardless of oxygen content. **OSHA has adopted an 8-hour Permissible Exposure Limit (PEL), also known as Time Weighted Average (TWA) of 5,000 ppm (0.5%) for carbon dioxide.** The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a Short Term Exposure Limit (STEL) of 30,000 ppm (3%). Persons should not be permitted in areas with concentrations above these levels.

Carbon dioxide cannot be detected by the human senses and will be inhaled like air. If adequate ventilation is not provided, it may displace normal air without warning. Since carbon dioxide is more dense than air, high concentrations can persist in open pits, tanks, or low areas. **Before entering any tank, pit, or other confined area where carbon dioxide may be present, carbon dioxide monitoring should be performed. If carbon dioxide is present, the area should be purged with air, or an air supplied respirator should be worn.** Store containers outdoors or in other well-ventilated areas to avoid the accumulation of potentially harmful concentrations.

W A R N I N G

WHEN LIQUID CARBON DIOXIDE IS RELEASED TO THE ATMOSPHERE, IT FORMS SOLID CARBON DIOXIDE (DRY ICE) WHICH IS EXTREMELY COLD (-109.3 °F) AND CAN CAUSE SEVERE FROSTBITE TO THE EYES OR SKIN.

Do not touch frosted pipes or valves. If accidental eye or skin contact with cold gas or dry ice occurs, consult a physician at once. ***Do not rub frozen body parts, as tissue damage may result.*** Remove any clothing that may restrict circulation to the frozen area. As soon as practical, place the affected part of the

body in a warm water bath which has a temperature not to exceed 105°F (40°C). Never use dry heat.

PROTECT EYES AND SKIN.

Protect your eyes with safety goggles and face shield, and cover the skin to prevent contact with the liquid, cold gas or solid. Protective gloves that can be quickly and easily removed and long sleeves are recommended for arm protection.

CARBON DIOXIDE SPECIAL PRECAUTIONS

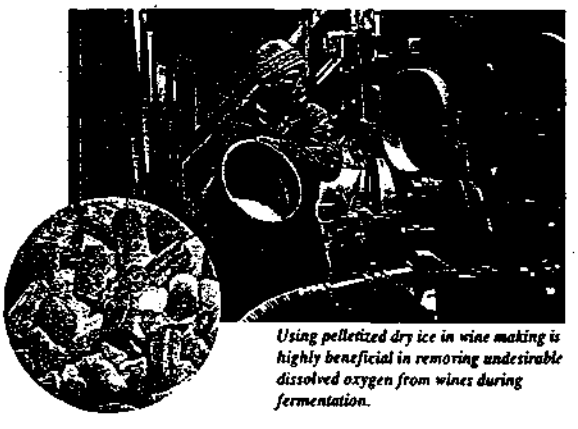
For *small uses*, carbon dioxide service is by withdrawal of gas from a cylinder. A small number of cylinders are equipped with a siphon or dip tube for liquid withdrawal. NEVER CONNECT A REGULATOR TO A CYLINDER EQUIPPED WITH A SIPHON OR DIP TUBE. The liquid will flash to gas and rupture the regulator. Cylinders equipped with siphon or dip tubes are identified by "siphon tube" stenciled on the cylinder sidewall.

SOLID CARBON DIOXIDE (DRY ICE) SPECIAL PRECAUTIONS

Dry ice is an extremely cold solid (-109.3 °F). Avoid contact with exposed flesh as it can cause severe frosbite. Wear suitable clothing and gloves when handling dry ice.

Dry ice evaporates (sublimes) to form carbon dioxide gas which does not support life. Do not breathe gas. Store and use dry ice with adequate ventilation.

Do not store dry ice in tight containers. Pressure will develop as the dry ice evaporates which could burst air tight containers.



Using pelletized dry ice in wine making is highly beneficial in removing undesirable dissolved oxygen from wines during fermentation.

IF IT IS NECESSARY TO DISPOSE OF WASTE GAS OR SOLID, EXERCISE CAUTION.

Carbon dioxide gas should be released only in an outdoor, well ventilated area. Allow dry ice to sublime (evaporate from solid to gas) in an outdoor, well ventilated area.

NITROUS OXIDE SAFETY PRECAUTIONS

Nitrous oxide (N_2O) is a colorless and nonflammable gas with a slightly sweetish odor and taste. Nitrous oxide is widely used as an anesthetic gas in concentrations of up to 50% with oxygen.

W A R N I N G

NITROUS OXIDE IS CLASSIFIED A SIMPLE ASPHYXIANT THAT CAN CAUSE DEATH IN CONFINED, POORLY VENTILATED AREAS BY DISPLACING THE OXYGEN WHICH IS NECESSARY TO SUSTAIN LIFE.

Atmospheres which do not contain enough oxygen for breathing (at least 19.5%) can cause dizziness, unconsciousness and death. When nitrous oxide is inhaled in high concentrations for a few seconds, it affects the central nervous system and may induce symptoms resembling intoxication, hence its nickname "Laughing Gas".

W A R N I N G

BECAUSE OF ITS WIDELY KNOWN INTOXICATING EFFECT, THIS GAS HAS OFTEN BEEN MISUSED RESULTING IN DEATH DUE TO SUFFOCATION. IT IS IMPORTANT THAT SECURITY OF NITROUS OXIDE CYLINDERS BE CONSIDERED TO PREVENT THEFT AND MISUSE.

Although nitrous oxide is classified as a simple asphyxiant (nontoxic), there are studies that suggest a link to certain health hazards from long-term exposure to high concentrations of nitrous oxide in the operating room or dental office. Because of these studies, the ACGIH (American Conference of Governmental Industrial Hygienists) has recommended a TLV of 50 ppm and the NIOSH (National Institute for Occupational Safety and Health) has recommended a maximum exposure on an 8-hour time weighted average (TWA) of 25 ppm for anesthesia administration and 50 ppm for dental offices. REFER TO YOUR MATERIAL SAFETY DATA SHEET FOR MORE DETAILED INFORMATION ON THE HEALTH HAZARDS OF NITROUS OXIDE.

W A R N I N G

WHILE NITROUS OXIDE IS NONFLAMMABLE, IT SUPPORTS AND CAN GREATLY ACCELERATE COMBUSTION IN A MANNER SIMILAR TO OXYGEN.

Nitrous oxide in storage must be separated from flammable liquids or gases and combustible materials (especially oil or grease) a minimum distance of 20 feet unless separated by a noncombustible barrier at least 5 feet high having a fire rating of at least one-half hour.

W A R N I N G

LIQUID NITROUS OXIDE IS VERY COLD (-129.1 °F), AND AS A LIQUID OR COLD GAS MAY CAUSE FROSTBITE TO THE EYES OR SKIN.

Do not touch frosted pipes or valves. If accidental eye or skin contact with liquid nitrous oxide occurs, consult a physician at once. **Do not rub frozen body parts, as tissue damage may result.** Remove any clothing that may restrict circulation to the frozen area. As soon as practical, place the affected part of the body in a warm water bath which has a temperature not to exceed 105°F (40°C). Never use dry heat.

PROTECT EYES AND SKIN.

Always handle liquid nitrous oxide so that it will not splash or spill. Protect eyes with safety goggles or face shield, and cover the skin to prevent contact with the liquid or cold gas. Clean, protective gloves that can be quickly and easily removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn outside of boots or work shoes to shed spilled liquid.

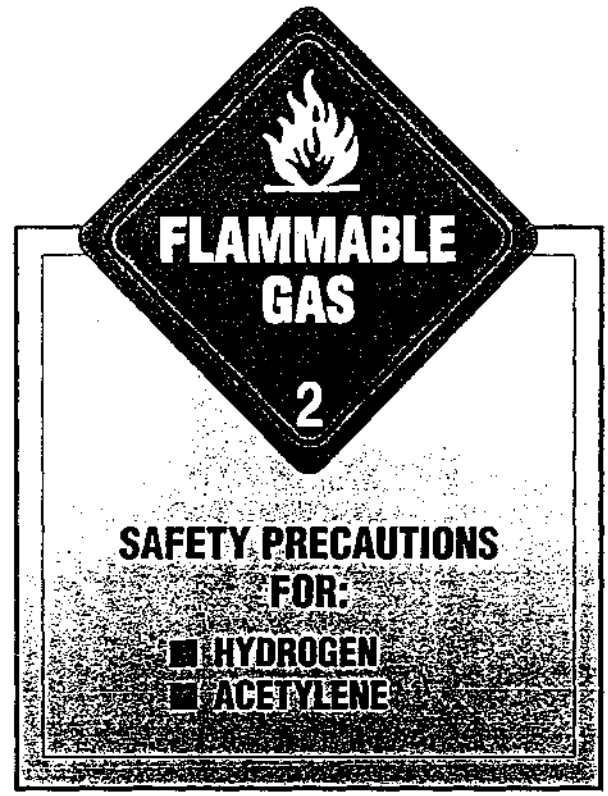
NITROUS OXIDE FOR MEDICAL USE

Nitrous oxide should be used for anesthetic purposes only if it is labeled "Nitrous Oxide, U.S.P.", and it is administered by licensed practitioners.

Nitrous Oxide is routinely used as an anesthetic gas in medical and dental applications.

IF IT IS NECESSSARY TO DISPOSE OF WASTE GAS OR LIQUID, EXERCISE CAUTION.

Gaseous and liquid nitrous oxide should be released only outdoors, downwind from personnel, combustible materials and sources of ignition.



HYDROGEN SAFETY PRECAUTIONS

Hydrogen (H_2) is a colorless, odorless, tasteless, nontoxic and flammable gas. It is the lightest of all elements.

W A R N I N G

HYDROGEN IS A FLAMMABLE GAS. A MIXTURE OF HYDROGEN WITH OXYGEN OR AIR IN A CONFINED SPACE WILL EXPLODE IF IGNITED BY A SPARK, FLAME, OR OTHER SOURCE OF IGNITION.

KEEP HYDROGEN AWAY FROM SOURCES OF IGNITION, AND DO NOT PERMIT ANY ACCUMULATION OF GAS.

Because it is lighter than air, hydrogen has a tendency to accumulate in the upper portions of confined areas. Concentrations of hydrogen between 4% and 75% by volume in air are relatively easy to ignite by a low-energy spark and may cause an explosion. Smoking, open flames, sparks, unapproved electrical equipment, and other ignition sources must not be permitted in hydrogen areas. Store containers outdoors or in a well-ventilated area away from ignition sources, flammable materials and oxidizers such as oxygen and nitrous oxide.

KEEP EQUIPMENT AREA WELL VENTILATED.

Although hydrogen is nontoxic, it can cause asphyxiation in a confined area that does not have adequate ventilation. Hydrogen gas cannot be detected by human senses; and if adequate ventilation is not provided, may displace normal air without warning. Any atmosphere which does not contain enough oxygen for breathing (at least 19.5%) can cause dizziness, unconsciousness, or even death. Store containers outdoors, or in other well ventilated areas. **Never enter any tank, pit, or other confined area where hydrogen may be present until purged with air and tested to ensure that it has an oxygen content between 19.5% and 23.5%. In addition, the confined space must be tested to ensure that there are no flammable gases present that exceed 10% of their Lower Explosive Limit (LEL).**

TAKE EVERY PRECAUTION AGAINST HYDROGEN LEAKS. ESCAPING HYDROGEN CANNOT BE DETECTED BY SMELL OR TASTE. HYDROGEN LEAKING UNDER PRESSURE CAN IGNITE DUE TO FRICTION AND WILL BURN WITH AN ALMOST INVISIBLE BLUE FLAME.

All hydrogen connections should be leak checked using a leak detection solution before use. NEVER USE A FLAME TO DETECT HYDROGEN LEAKS!

W A R N I N G

LIQUID HYDROGEN IS EXTREMELY COLD (- 423.0 °F) AND AS A LIQUID OR COLD GAS MAY CAUSE SEVERE FROSTBITE TO THE EYES OR SKIN.

Do not touch frosted pipes or valves. If accidental eye or skin contact with liquid hydrogen occurs, consult a physician at once. **Do not rub frozen body parts, as tissue damage may result.** Remove any clothing that may restrict circulation to the frozen area. As soon as practical, place the affected part of the body in a warm water bath which has a temperature not to exceed 105°F (40°C). Never use dry heat.

PROTECT SKIN AND EYES.

Always handle liquid hydrogen so that it will not splash or spill. Protect your eyes with safety goggles or face shield, and cover the skin to prevent contact with the liquid or cold gas. Clean, protective gloves that can be quickly and easily removed, and long sleeves are recommended for arm protection. Cuffless trousers should be worn outside boots or work shoes to shed spilled liquid.

LIQUID-TO-GAS EXPANSION

Cryogenic liquids produce large quantities of gas when they vaporize. Liquid hydrogen will expand at a ratio of 1:850, liquid to gas. If liquid hydrogen is trapped in a sealed container or piping, it will vaporize, producing enormous pressures which could cause the container to rupture violently if not protected by a pressure relief device.

VAPOR CLOUD OR FOG

Cryogenic liquids and their "boil-off" vapors are extremely cold and have a built-in warning property that appears whenever they are exposed to the atmosphere. The cold "boil-off" gases condense the moisture in the air, creating a highly visible fog or vapor cloud. This fog normally extends over a larger area than the vaporizing gas.

If a large vapor cloud forms after a liquid spill, you should avoid this cloud because of possible flammable atmospheres or reduced visibility. In addition, all sources of ignition should be shut off in the path of the vapor cloud, if possible.

Small fog areas may appear during liquid transfer as the cold piping condenses moisture in the surrounding air.

LIQUID HYDROGEN SPECIAL PRECAUTIONS

The extremely low temperature of liquid hydrogen (- 423.0 °F) can solidify any gas except helium. Such solidified gases can plug pressure-relief passages and devices, making them ineffective in relieving excess pressure from evaporating liquid. Always store and handle liquid hydrogen under positive pressure and in closed systems to prevent infiltration and solidification of air or other gases.

Keep exterior surfaces of liquid hydrogen equipment clean. Oxygen can condense from the air on exposed liquid hydrogen or cold-gas equipment surfaces, such as vaporizers and piping. To prevent the possible ignition of grease, oil, or other combustible materials with the condensed oxygen, keep these surfaces clean.

NEVER USE CONTAINERS, EQUIPMENT, OR REPLACEMENT PARTS OTHER THAN THOSE SPECIFICALLY DESIGNATED FOR USE IN HYDROGEN SERVICE.

Observe all applicable safety codes when installing hydrogen equipment.

Follow the recommendations contained in NFPA Standards 50A, "Gaseous Hydrogen Systems at Consumer Sites", and 50B, "Liquefied Hydrogen Systems at Consumer Sites", and with all local safety codes when installing hydrogen equipment or systems.

IF IT IS NECESSARY TO DISPOSE OF WASTE GAS OR LIQUID, EXERCISE CAUTION.

Liquid and gaseous hydrogen must be disposed of outdoors in an isolated area away from personnel, combustible materials, and ignition sources. Liquid hydrogen for disposal should be completely vaporized and the vapor vented in a safe manner. **Remember that a flammable mixture will exist for some distance downwind of the disposal area.** A shallow aluminum pan makes a suitable flash evaporator for disposal of moderately small quantities of liquid hydrogen.

ACETYLENE SAFETY PRECAUTIONS

Acetylene (C_2H_2) is a colorless, non-toxic, flammable gas with a distinctive garlic-like odor.

W A R N I N G

ACETYLENE IS A FLAMMABLE GAS. A MIXTURE OF ACETYLENE WITH OXYGEN OR AIR IN A CONFINED AREA WILL EXPLODE IF IGNITED BY A SPARK, FLAME OR OTHER SOURCE OF IGNITION.

KEEP ACETYLENE AWAY FROM SOURCES OF IGNITION, AND DO NOT PERMIT ANY ACCUMULATION OF GAS.

Concentrations of acetylene between 2.5% and 81% by volume in air are relatively easy to ignite by low-energy sparks and may cause an explosion. Smoking, open flames, sparks, unapproved electrical equipment and other ignition sources must not be permitted in acetylene storage areas. Store cylinders outdoors or in other well ventilated areas away from ignition sources, other flammable materials, and oxidizers such as oxygen and nitrous oxide.

NEVER USE EQUIPMENT OR CYLINDERS THAT ARE LEAKING ACETYLENE

Be certain that the regulator-to-cylinder valve, hose-to-regulator and the torch-to-hose connections are leak tight by leak checking with a leak detection solution before starting work. NEVER USE A FLAME TO DETECT ACETYLENE LEAKS!

Regulators, hoses, and torches must be properly maintained to work correctly and safely. If an acetylene valve should leak around the cylinder-valve stem when the valve is opened, close the valve and tighten the packing gland nut. If this does not stop the leak, contact the supplier immediately.

DO NOT TAMPER WITH FUSIBLE METAL PRESSURE RELIEF DEVICES OR CYLINDER VALVES.

Acetylene cylinders are equipped with fusible metal pressure relief devices which melt at about 212 °F, the boiling point of water. These devices are designed to release the acetylene in the event of an abnormally high temperature, as in a fire. These fusible metal pressure relief devices are threaded into the top and/or bottom of most cylinders. Fusible-metal channels may also be provided in the valve body on smaller cylinders. Do not tamper with these fusible metal pressure relief devices or permit a torch flame to come in contact with them. Keep cylinders away from overhead and ground-level welding and cutting operations to prevent flying sparks and slag from accumulating on or around the cylinder which could cause fusible metal pressure relief devices to melt, releasing acetylene which could be ignited.

Protect all cylinders from falling objects and avoid rough handling of cylinders to prevent damage to the fusible plugs or cylinder valves. **Always store, transport, and use acetylene cylinders in a vertical position.**

KEEP EQUIPMENT AREA WELL VENTILATED

Although acetylene is nontoxic, it is an anesthetic and can cause asphyxiation in a confined area that does not have adequate ventilation. Any atmosphere which does not contain enough oxygen for breathing (at least 19.5%) can cause dizziness, unconsciousness, or death. If adequate ventilation is not provided, acetylene may displace normal air. Acetylene can be detected by its distinctive garlic-like odor. If the odor of acetylene is noticed, immediately attempt to locate the source of the leak and correct it. If a leak in a cylinder or connected apparatus cannot be stopped safely, contact the gas supplier. If possible, the cylinder should be moved to a well ventilated area away form possible ignition sources. **Never store, use, or transport acetylene cylinders in confined or unventilated spaces, such as cabinets, closets, tool boxes, and especially in automobile trunks.**

ACETYLENE SPECIAL PRECAUTIONS

W A R N I N G

ACETYLENE USED AT PRESSURES GREATER THAN 15 PSIG IS EXTREMELY UNSTABLE AND MAY DECOMPOSE VIOLENTLY.

Always use a regulator designed for acetylene use. Never adjust the acetylene regulator to obtain a delivery pressure greater than 15 psig. **Never open an acetylene cylinder valve more than one complete turn.**

W A R N I N G

NEVER USE CONTAINERS, EQUIPMENT, PIPING OR REPLACEMENT PARTS OTHER THAN THOSE SPECIFICALLY DESIGNED FOR USE IN ACETYLENE SERVICE.

Under certain conditions, acetylene forms readily explosive compounds with copper, silver, and mercury. Contact should be avoided between acetylene and these metals, their salts, compounds, and high concentration alloys.

Acetylene cylinders differ from all other compressed gas cylinders in that they are packed with a porous mass that is saturated with a solvent, usually acetone. During the filling process acetylene gas is dissolved into this solvent to avoid the decomposition characteristics of gaseous acetylene.

Never under any circumstances, attempt to transfer acetylene from one cylinder to another or to mix any gas with acetylene in a cylinder.

OBSERVE ALL APPLICABLE SAFETY CODES WHEN USING ACETYLENE.

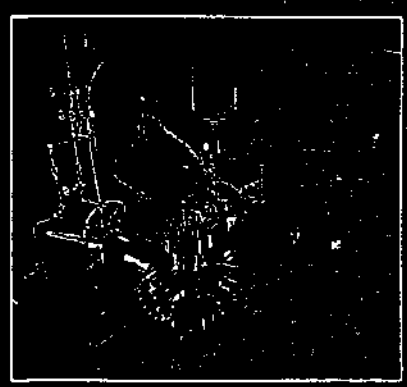
Follow the recommendations found in ANSI Standard Z49.1, "Safety in Welding and Cutting", and NFPA Standard No. 51, "Oxygen-Fuel Gas Systems for Welding and Cutting" before installing or using equipment and cylinders in acetylene service.

An automated oxy-acetylene cutting machine.

SPECIALTY GAS AND GAS MIXTURES

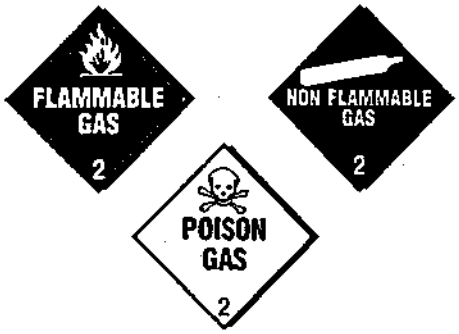
Specialty gases are special-purpose liquids, gases and multi-component mixtures in any compatible combination. They may include atmospheric gases, chemicals and volatile liquids. Specialty gases are widely used for:

- Analytical and calibration standards
- Electron capture
- Lasers
- Welding



The power and amplitude of this research laser is determined by the ultra-pure gas mixtures used.

SPECIALTY GAS AND GAS MIXTURES SAFETY PRECAUTIONS

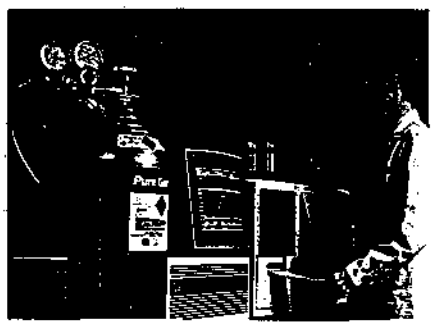


W A R N I N G

MANY SPECIALTY GASES (INCLUDING MIXTURES) HAVE FLAMMABLE, TOXIC, CORROSIVE, OXIDIZING, PYROPHORIC, AND OTHER HAZARDOUS PROPERTIES. THESE GASES CAN CAUSE PROPERTY DAMAGE, AS WELL AS SERIOUS OR FATAL INJURIES IF PROPER SAFETY PRECAUTIONS ARE NOT FOLLOWED.

INHALATION OF SOME TOXIC SPECIALTY GASES CAN BE FATAL IN VERY LOW CONCENTRATIONS WHILE OTHERS CAN CAUSE SPECIFIC ORGAN DAMAGE AFTER REPEATED EXPOSURE.

In addition, some specialty gases can cause simple asphyxiation by displacing the oxygen in the atmosphere, while corrosive gases can cause serious eye or skin damage upon contact; and flammable gases can present fire and explosion hazards.



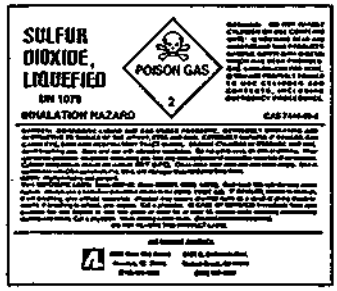
Highly precise reference gas for scientific instrumentation.

OBTAIN SAFETY INFORMATION BEFORE HANDLING SPECIALTY GASES

Because of the great number of specialty gases and gas mixtures available, and the variety of hazardous properties of these gases, it is not possible to cover all safety precautions for specialty gases in this pamphlet. If you are not familiar with the handling of specialty gases and their hazardous properties, contact your supplier. Also available are Material Safety Data Sheets (MSDS) presenting the hazardous properties and safe handling procedures for each specialty gas.

READ THE PRECAUTIONARY LABEL ON THE CYLINDER.

READ THE LABEL
TO IDENTIFY THE GAS!



This is an important warning applying to all gas cylinders, but it is particularly important for specialty gases because of their unique and varied hazardous properties.

Users of specialty gases are urged to be certain that employees read and follow the precautionary information on all gas cylinder labels. If a cylinder is received with missing, damaged, or illegible precautionary labels, do not use the cylinder, call your gas supplier.

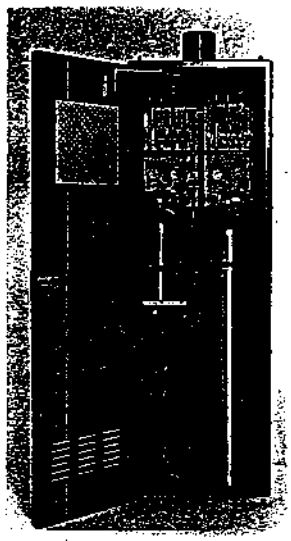
DO NOT PERMIT UNTRAINED PERSONS TO HANDLE SPECIALTY GASES.

Because of the extremely hazardous properties of some specialty gases and their applications, employees must be trained in their safe handling and use.

SPECIAL PRECAUTIONS

When two or more gases, or liquefied gases are mixed, their properties may combine to create additional hazards. Obtain and evaluate the safety information for each component and for the mixture before use.

Special handling and storage precautions must be taken when working with toxic, pyrophoric or corrosive specialty gases. Because of their hazardous nature, many gases may require the use of special personal protective equipment such as respirators, chemical resistant gloves and clothing and nearby eye wash and safety showers.



In many instances Federal, State or local fire codes and regulations may govern or restrict the handling and storage of these gases. One safe usage alternative is the use of a cylinder gas storage cabinet (left). These fully enclosed units will normally hold from one to four cylinders. The cabinets are designed to permit air changes with an exhaust system that will safely carry away any inadvertently released product and many are equipped with leak detection and fire suppression systems. The cabinets can be set up to be fully automated or operated manually with little or no potential exposure to personnel.

IF NECESSARY TO DISPOSE OF WASTE GAS, EXERCISE EXTREME CAUTION.

No attempt should be made to dispose of any gas mixtures before determining the following:

1. What gases are in the mixture?
2. At what concentrations are they present?
3. What is the total quantity for disposal?
4. Is the mixture subject to environmental regulations?

In many cases, sophisticated and expensive scrubbing equipment is necessary to destroy residual gases. It is best to return the unused portion of any gas or gas mixture to your supplier for disposal.

ADDITIONAL INFORMATION

For further technical information about any of these gases or other unlisted gases refer to the "Material Safety Data Sheet" (MSDS), the Air Liquide "Encyclopedie Des Gaz", or to the Air Liquide America video "Hazards of Liquefied and Compressed Gases."

Additional product information about these and other gases can be found in publications and videos produced by the Compressed Gas Association (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, Virginia, ZIP 22202, Tel.: 1 (703) 412-0900.

G-1	"Acetylene"
G-1.1	"Commodity Specification for Acetylene"
G-4	"Oxygen"
G-4.1	"Cleaning Equipment for Oxygen Service"
G-4.3	"Commodity Specification for Oxygen"
G-5	"Hydrogen"
G-5.3	"Commodity Specification for Hydrogen"
G-6	"Carbon Dioxide"
G-6.2	"Commodity Specification for Carbon Dioxide"
G-7	"Compressed Air for Human Respiration"
G-7.1	"Commodity Specification for Air"
G-8.2	"Commodity Specification for Nitrous Oxide"
G-9.1	"Commodity Specification for Helium"
G-10.1	"Commodity Specification for Nitrogen"
G-11.1	"Commodity Specification for Argon"
P-1	"Safe Handling of Compressed Gases in Containers"
P-2	"Characteristics and Safe Handling of Medical Gases"
P-9	"The Inert Gases Argon, Nitrogen and Helium"
P-12	"Safe Handling of Cryogenic Liquids"
P-14	"Accident Prevention in Oxygen-Rich and Oxygen-Deficient Atmospheres"
SB-2	"Oxygen-Deficient Atmospheres"
SB-4	"Handling Acetylene Cylinders in Fire Situations"
SB-8	"Use of Oxy-Fuel Gas Welding and Cutting Apparatus"
SB-14	"Helium Gas for Filling Balloons"
AV-1	"Safe Handling and Storage of Compressed Gases"
AV-4	"Characteristics and Safe Handling of Medical Gases"
AV-5	"Safe Handling of Liquefied Nitrogen and Argon"
AV-6	"Highway Transportation of Gases"
AV-7	"Characteristics and Safe Handling of Carbon Dioxide"
AV-8	"Characteristics and Safe Handling of Cryogenic Liquid and Gaseous Oxygen"
AV-9	"Handling Acetylene Cylinders in Fire Situations"

IN THE EVENT OF AN EMERGENCY INVOLVING ANY TYPE OF GAS, CALL THE FOLLOWING EMERGENCY RESPONSE TELEPHONE NUMBER FOR THE AREA IN WHICH THE EMERGENCY HAS OCCURRED.

These Emergency Response telephone numbers also appear on all Air Liquide America shipping papers.

IN TEXAS, OKLAHOMA, and LOUSIANA... Call the Air Liquide America Operations Control Center in Houston, Texas: 1 (800) 364-7378

IN ALL OTHER STATES... Call CHEMTREC: 1 (800) 424-9300

AIR LIQUIDE

AIR LIQUIDE AMERICA

3535 West 12th Street	2121 N. California Blvd.
Houston, TX 77008	Walnut Creek, CA 94596
(713) 868-0333	(510) 977-6500

AIR LIQUIDE AMERICA GASES SUPPLIED BY:

Printed in USA

HER 01028

HERCULES OFFSHORE CO.

INVOICE NO. 3480

MARINE REPAIR ORDER No. 7-5135

MARINE OPERATIONS FACILITY

CUSTOMER P.O. _____

DATE

ORDER WRITTEN: 7/25/96	ETA: 7/26/96 2200
ARRIVAL	
COMPLETION DATE	
DEPARTURE DATE	

M/V ☐ BARGE ☒ NAME: ETT 112

LOA | WIDTH

FOREMAN: Claudio Duarte

LAST PRODUCT

GAS FREEING YES ☐ NO ☐ CERTIFICATE REQUIRED YES ☐ NO ☐

HAUL OUT FOR INSPECTION AND REPAIR YES ☐ NO ☐

ON WAYS DATE: _____

ON WAYS DATE: _____

CUSTOMER

NAME: BASF

BILLING ADDRESS: 607 Copper Road

CITY AND STATE: Freeport, Tx 77541

PHONE NUMBER: 238-6161

WORK AUTHORIZED BY: R. Peters | O/T AUTHORIZED BY

STOCK MATERIAL ☒ YES ☐ NO

IF YES, COMPLETE STOCK MATERIAL TRANSFER TICKET

OUTSIDE SERVICES IF YES, LIST ☒ YES ☐ NO

② Air Liquide 7/27/96 - 1230 ~~0815~~

ITEM NUMBERS

1 strip + blow dry

2 nitrogen purge

3 ballast

4

5

6

7

8

9

10

THIS SHALL SERVE AS YOUR AUTHORIZATION TO PROCEED WITH THE ABOVE.

Signed: _____ Date: _____

HER 01029

HERCULES OFFSHORE CO.

3500

INVOICE NO. ~~37480~~

MARINE REPAIR ORDER No. 7-5135

MARINE OPERATIONS FACILITY

CUSTOMER P.O. _____

DATE

ORDER WRITTEN: 7/25/96	ETA: 7/26/96 2200
ARRIVAL:	
COMPLETION DATE:	
DEPARTURE DATE:	

M/V ☐ BARGE ☒ NAME: ETT 112

LOA: | WIDTH:

FOREMAN: Claudio Duarte

LAST PRODUCT:

GAS FREEING YES ☐ NO ☐ CERTIFICATE REQUIRED YES ☐ NO ☐

HAUL OUT FOR INSPECTION AND REPAIR YES ☐ NO ☐

ON WAYS DATE: _____

ON WAYS DATE: _____

CUSTOMER

NAME: BASF

BILLING ADDRESS: 607 Copper Road

CITY AND STATE: Freeport, Tx 77541

PHONE NUMBER: 238-6161

WORK AUTHORIZED BY: R. Peters | O/Y AUTHORIZED BY:

STOCK MATERIAL ☒ YES ☐ NO

IF YES, COMPLETE STOCK MATERIAL TRANSFER TICKET

OUTSIDE SERVICES IF YES, LIST ☒ YES ☐ NO

(2) Air Liquide 7/27/96-0302

ITEM NUMBERS

1 Strip + blast dry / Deballast Bow Rake to repair Pin Hole on Bulkhead between Bow & W/T #1 Port side. Apply Temp Patch.

2 nitrogen purge

3 ballast

4

5

6

7

8

9

10

THIS SHALL SERVE AS YOUR AUTHORIZATION TO PROCEED WITH THE ABOVE.

Signed: Claudio Duarte Date: 7-26-96

HER 01030

0705860 00
0711229 00

ETT=112
7-27-86
BALLAST BOW
WING TANK nc=4

64300